US009733821B2

(12) **United States Patent**
Fleizach

(10) **Patent No.: US 9,733,821 B2**
(45) **Date of Patent: Aug. 15, 2017**

(54) **VOICE CONTROL TO DIAGNOSE INADVERTENT ACTIVATION OF ACCESSIBILITY FEATURES**

(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(72) Inventor: **Christopher B. Fleizach**, Morgan Hill, CA (US)

(73) Assignee: **APPLE INC.**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 360 days.

(21) Appl. No.: **14/195,325**

(22) Filed: **Mar. 3, 2014**

(65) **Prior Publication Data**

US 2014/0282007 A1 Sep. 18, 2014

Related U.S. Application Data

(60) Provisional application No. 61/785,853, filed on Mar. 14, 2013.

(51) **Int. Cl.**

G06F 3/16	(2006.01)
G06F 3/0487	(2013.01)
G06F 3/0481	(2013.01)
G06F 9/44	(2006.01)
G06F 9/445	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 3/0487*** (2013.01); ***G06F 3/167*** (2013.01); ***G06F 9/4446*** (2013.01); *G06F 3/0481* (2013.01); *G06F 3/16* (2013.01); *G06F 9/4443* (2013.01); *G06F 9/44505* (2013.01)

(58) **Field of Classification Search**

USPC 715/728, 716, 729, 747, 807, 823

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,704,345	A	11/1972	Coker et al.
3,828,132	A	8/1974	Flanagan et al.
3,979,557	A	9/1976	Schulman et al.
4,278,838	A	7/1981	Antonov
4,282,405	A	8/1981	Taguchi
4,310,721	A	1/1982	Manley et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CH	681573 A5	4/1993
DE	3837590 A1	5/1990

(Continued)

OTHER PUBLICATIONS

Don Labriola, Give Yourself a 3-D hand, Aug. 1996, SX2 Media Labs LLC, v16, p. 359.*

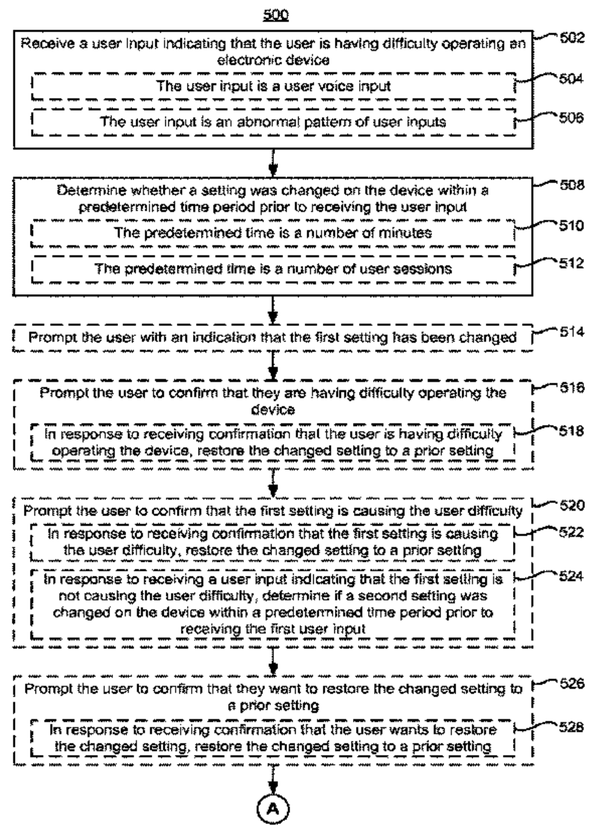
(Continued)

Primary Examiner — Linh K Pham
Assistant Examiner — Tam Tran
(74) *Attorney, Agent, or Firm* — Morrison & Foerster LLP

(57) **ABSTRACT**

Methods and systems are provided for diagnosing inadvertent activation of user interface settings on an electronic device. The electronic device receives a user input indicating that the user is having difficulty operating the electronic device. The device then determines whether a setting was changed on the device within a predetermined time period prior to receiving the user input. When a first setting was changed within the predetermined time period prior to receiving the user input, the device restores the changed setting to a prior setting.

24 Claims, 13 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

4,348,553	A	9/1982	Baker et al.
4,653,021	A	3/1987	Takagi
4,688,195	A	8/1987	Thompson et al.
4,692,941	A	9/1987	Jacks et al.
4,718,094	A	1/1988	Bahl et al.
4,724,542	A	2/1988	Williford
4,726,065	A	2/1988	Froessl
4,727,354	A	2/1988	Lindsay
4,776,016	A	10/1988	Hansen
4,783,807	A	11/1988	Marley
4,811,243	A	3/1989	Racine
4,819,271	A	4/1989	Bahl et al.
4,827,518	A	5/1989	Feustel et al.
4,827,520	A	5/1989	Zeinstra
4,829,576	A	5/1989	Porter
4,833,712	A	5/1989	Bahl et al.
4,839,853	A	6/1989	Deerwester et al.
4,852,168	A	7/1989	Sprague
4,862,504	A	8/1989	Nomura
4,878,230	A	10/1989	Murakami et al.
4,903,305	A	2/1990	Gillick et al.
4,905,163	A	2/1990	Garber et al.
4,914,586	A	4/1990	Swinehart et al.
4,914,590	A	4/1990	Loatman et al.
4,944,013	A	7/1990	Gouvianakis et al.
4,955,047	A	9/1990	Morganstein et al.
4,965,763	A	10/1990	Zamora
4,974,191	A	11/1990	Amirghodsi et al.
4,977,598	A	12/1990	Doddington et al.
4,992,972	A	2/1991	Brooks et al.
5,010,574	A	4/1991	Wang
5,020,112	A	5/1991	Chou
5,021,971	A	6/1991	Lindsay
5,022,081	A	6/1991	Hirose et al.
5,027,406	A	6/1991	Roberts et al.
5,031,217	A	7/1991	Nishimura
5,032,989	A	7/1991	Tornetta
5,040,218	A	8/1991	Vitale et al.
5,047,617	A	9/1991	Shepard et al.
5,057,915	A	10/1991	Von Kohorn
5,072,452	A	12/1991	Brown et al.
5,091,945	A	2/1992	Kleijn
5,127,053	A	6/1992	Koch
5,127,055	A	6/1992	Larkey
5,128,672	A	7/1992	Kaehler
5,133,011	A	7/1992	McKiel, Jr.
5,142,584	A	8/1992	Ozawa
5,164,900	A	11/1992	Bernath
5,165,007	A	11/1992	Bahl et al.
5,179,627	A	1/1993	Sweet et al.
5,179,652	A	1/1993	Rozmanith et al.
5,194,950	A	3/1993	Murakami et al.
5,197,005	A	3/1993	Shwartz et al.
5,199,077	A	3/1993	Wilcox et al.
5,202,952	A	4/1993	Gillick et al.
5,208,862	A	5/1993	Ozawa
5,216,747	A	6/1993	Hardwick et al.
5,220,639	A	6/1993	Lee
5,220,657	A	6/1993	Bly et al.
5,222,146	A	6/1993	Bahl et al.
5,230,036	A	7/1993	Akamine et al.
5,235,680	A	8/1993	Bijnagte
5,267,345	A	11/1993	Brown et al.
5,268,990	A	12/1993	Cohen et al.
5,282,265	A	1/1994	Rohra Suda et al.
RE34,562	E	3/1994	Murakami et al.
5,291,286	A	3/1994	Murakami et al.
5,293,448	A	3/1994	Honda
5,293,452	A	3/1994	Picone et al.
5,297,170	A	3/1994	Eyuboglu et al.
5,301,109	A	4/1994	Landauer et al.
5,303,406	A	4/1994	Hansen et al.
5,309,359	A	5/1994	Katz et al.
5,317,507	A	5/1994	Gallant
5,317,647	A	5/1994	Pagallo
5,325,297	A	6/1994	Bird et al.
5,325,298	A	6/1994	Gallant
5,327,498	A	7/1994	Hamon
5,333,236	A	7/1994	Bahl et al.
5,333,275	A	7/1994	Wheatley et al.
5,345,536	A	9/1994	Hoshimi et al.
5,349,645	A	9/1994	Zhao
5,353,377	A	10/1994	Kuroda et al.
5,377,301	A	12/1994	Rosenberg et al.
5,384,892	A	1/1995	Strong
5,384,893	A	1/1995	Hutchins
5,386,494	A	1/1995	White
5,386,556	A	1/1995	Hedin et al.
5,390,279	A	2/1995	Strong
5,396,625	A	3/1995	Parkes
5,400,434	A	3/1995	Pearson
5,404,295	A	4/1995	Katz et al.
5,412,756	A	5/1995	Bauman et al.
5,412,804	A	5/1995	Krishna
5,412,806	A	5/1995	Du et al.
5,418,951	A	5/1995	Damashek
5,424,947	A	6/1995	Nagao et al.
5,434,777	A	7/1995	Luciw
5,444,823	A	8/1995	Nguyen
5,455,888	A	10/1995	Iyengar et al.
5,469,529	A	11/1995	Bimbot et al.
5,471,611	A	11/1995	McGregor
5,475,587	A	12/1995	Anick et al.
5,479,488	A	12/1995	Lennig et al.
5,491,772	A	2/1996	Hardwick et al.
5,493,677	A	2/1996	Balogh et al.
5,495,604	A	2/1996	Harding et al.
5,502,790	A	3/1996	Yi
5,502,791	A	3/1996	Nishimura et al.
5,515,475	A	5/1996	Gupta et al.
5,536,902	A	7/1996	Serra et al.
5,537,618	A	7/1996	Boulton et al.
5,574,823	A	11/1996	Hassanein et al.
5,577,241	A	11/1996	Spencer
5,578,808	A	11/1996	Taylor
5,579,436	A	11/1996	Chou et al.
5,581,655	A	12/1996	Cohen et al.
5,584,024	A	12/1996	Shwartz
5,596,676	A	1/1997	Swaminathan et al.
5,596,994	A	1/1997	Bro
5,608,624	A	3/1997	Luciw
5,613,036	A	3/1997	Strong
5,617,507	A	4/1997	Lee et al.
5,619,694	A	4/1997	Shimazu
5,621,859	A	4/1997	Schwartz et al.
5,621,903	A	4/1997	Luciw et al.
5,642,464	A	6/1997	Yue et al.
5,642,519	A	6/1997	Martin
5,644,727	A	7/1997	Atkins
5,664,055	A	9/1997	Kroon
5,675,819	A	10/1997	Schuetze
5,682,539	A	10/1997	Conrad et al.
5,687,077	A	11/1997	Gough, Jr.
5,696,962	A	12/1997	Kupiec
5,701,400	A	12/1997	Amado
5,706,442	A	1/1998	Anderson et al.
5,710,886	A	1/1998	Christensen et al.
5,712,957	A	1/1998	Waibel et al.
5,715,468	A	2/1998	Budzinski
5,721,827	A	2/1998	Logan et al.
5,727,950	A	3/1998	Cook et al.
5,729,694	A	3/1998	Holzrichter et al.
5,732,216	A	3/1998	Logan et al.
5,732,390	A	3/1998	Katayanagi et al.
5,734,791	A	3/1998	Acero et al.
5,737,734	A	4/1998	Schultz
5,748,974	A	5/1998	Johnson
5,749,081	A	5/1998	Whiteis
5,759,101	A	6/1998	Von Kohorn
5,790,978	A	8/1998	Olive et al.
5,794,050	A	8/1998	Dahlgren et al.
5,794,182	A	8/1998	Manduchi et al.
5,794,207	A	8/1998	Walker et al.
5,794,237	A	8/1998	Gore, Jr.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,799,276	A	8/1998	Komissarchik et al.
5,822,743	A	10/1998	Gupta et al.
5,825,881	A	10/1998	Colvin, Sr.
5,826,261	A	10/1998	Spencer
5,828,999	A	10/1998	Bellegarda et al.
5,835,893	A	11/1998	Ushioda
5,839,106	A	11/1998	Bellegarda
5,845,255	A	12/1998	Mayaud
5,857,184	A	1/1999	Lynch
5,860,063	A	1/1999	Gorin et al.
5,862,233	A	1/1999	Poletti
5,864,806	A	1/1999	Mokbel et al.
5,864,844	A	1/1999	James et al.
5,867,799	A	2/1999	Lang et al.
5,873,056	A	2/1999	Liddy et al.
5,875,437	A	2/1999	Atkins
5,884,323	A	3/1999	Hawkins et al.
5,895,464	A	4/1999	Bhandari et al.
5,895,466	A	4/1999	Goldberg et al.
5,899,972	A	5/1999	Miyazawa et al.
5,913,193	A	6/1999	Huang et al.
5,915,249	A	6/1999	Spencer
5,930,769	A	7/1999	Rose
5,933,822	A	8/1999	Braden-Harder et al.
5,936,926	A	8/1999	Yokouchi et al.
5,940,811	A	8/1999	Norris
5,941,944	A	8/1999	Messerly
5,943,670	A	8/1999	Prager
5,948,040	A	9/1999	DeLorme et al.
5,956,699	A	9/1999	Wong et al.
5,960,394	A	9/1999	Gould et al.
5,960,422	A	9/1999	Prasad
5,963,924	A	10/1999	Williams et al.
5,966,126	A	10/1999	Szabo
5,970,474	A	10/1999	LeRoy et al.
5,974,146	A	10/1999	Randle et al.
5,982,891	A	11/1999	Ginter et al.
5,987,132	A	11/1999	Rowney
5,987,140	A	11/1999	Rowney et al.
5,987,404	A	11/1999	Della Pietra et al.
5,987,440	A	11/1999	O'Neil et al.
5,999,908	A	12/1999	Abelow
6,016,471	A	1/2000	Kuhn et al.
6,023,684	A	2/2000	Pearson
6,024,288	A	2/2000	Gottlich et al.
6,026,345	A	2/2000	Shah et al.
6,026,375	A	2/2000	Hall et al.
6,026,388	A	2/2000	Liddy et al.
6,026,393	A	2/2000	Gupta et al.
6,029,132	A	2/2000	Kuhn et al.
6,038,533	A	3/2000	Buchsbaum et al.
6,052,656	A	4/2000	Suda et al.
6,055,514	A	4/2000	Wren
6,055,531	A	4/2000	Bennett et al.
6,064,960	A	5/2000	Bellegarda et al.
6,070,139	A	5/2000	Miyazawa et al.
6,070,147	A	5/2000	Harms et al.
6,076,051	A	6/2000	Messerly et al.
6,076,088	A	6/2000	Paik et al.
6,078,914	A	6/2000	Redfern
6,081,750	A	6/2000	Hoffberg et al.
6,081,774	A	6/2000	de Hita et al.
6,088,731	A	7/2000	Kiraly et al.
6,094,649	A	7/2000	Bowen et al.
6,105,865	A	8/2000	Hardesty
6,108,627	A	8/2000	Sabourin
6,119,101	A	9/2000	Peckover
6,122,616	A	9/2000	Henton
6,125,356	A	9/2000	Brockman et al.
6,144,938	A	11/2000	Surace et al.
6,173,261	B1	1/2001	Arai et al.
6,173,279	B1	1/2001	Levin et al.
6,188,999	B1	2/2001	Moody
6,195,641	B1	2/2001	Loring et al.
6,205,456	B1	3/2001	Nakao
6,208,971	B1	3/2001	Bellegarda et al.
6,233,559	B1	5/2001	Balakrishnan
6,233,578	B1	5/2001	Machihara et al.
6,246,981	B1	6/2001	Papineni et al.
6,260,024	B1	7/2001	Shkedy
6,266,637	B1	7/2001	Donovan et al.
6,275,824	B1	8/2001	O'Flaherty et al.
6,285,786	B1	9/2001	Seni et al.
6,308,149	B1	10/2001	Gaussier et al.
6,311,189	B1	10/2001	deVries et al.
6,317,594	B1	11/2001	Gossman et al.
6,317,707	B1	11/2001	Bangalore et al.
6,317,831	B1	11/2001	King
6,321,092	B1	11/2001	Fitch et al.
6,334,103	B1	12/2001	Surace et al.
6,356,854	B1	3/2002	Schubert et al.
6,356,905	B1	3/2002	Gershman et al.
6,366,883	B1	4/2002	Campbell et al.
6,366,884	B1	4/2002	Bellegarda et al.
6,421,672	B1	7/2002	McAllister et al.
6,434,524	B1	8/2002	Weber
6,446,076	B1	9/2002	Burkey et al.
6,449,620	B1	9/2002	Draper et al.
6,453,281	B1	9/2002	Walters et al.
6,453,292	B2	9/2002	Ramaswamy et al.
6,460,029	B1	10/2002	Fries et al.
6,466,654	B1	10/2002	Cooper et al.
6,477,488	B1	11/2002	Bellegarda
6,487,534	B1	11/2002	Thelen et al.
6,499,013	B1	12/2002	Weber
6,501,937	B1	12/2002	Ho et al.
6,505,158	B1	1/2003	Conkie
6,505,175	B1	1/2003	Silverman et al.
6,505,183	B1	1/2003	Loofbourrow et al.
6,510,417	B1	1/2003	Woods et al.
6,513,063	B1	1/2003	Julia et al.
6,519,565	B1	2/2003	Clements et al.
6,523,061	B1	2/2003	Halverson et al.
6,523,172	B1	2/2003	Martinez-Guerra et al.
6,526,382	B1	2/2003	Yuschik
6,526,395	B1	2/2003	Morris
6,532,444	B1	3/2003	Weber
6,532,446	B1	3/2003	King
6,546,388	B1	4/2003	Edlund et al.
6,553,344	B2	4/2003	Bellegarda et al.
6,556,983	B1	4/2003	Altschuler et al.
6,584,464	B1	6/2003	Warthen
6,598,039	B1	7/2003	Livowsky
6,601,026	B2	7/2003	Appelt et al.
6,601,234	B1	7/2003	Bowman-Amuah
6,604,059	B2	8/2003	Strubbe et al.
6,615,172	B1	9/2003	Bennett et al.
6,615,175	B1	9/2003	Gazdzinski
6,615,220	B1	9/2003	Austin et al.
6,625,583	B1	9/2003	Silverman et al.
6,631,346	B1	10/2003	Karaorman et al.
6,633,846	B1	10/2003	Bennett et al.
6,647,260	B2	11/2003	Dusse et al.
6,650,735	B2	11/2003	Burton et al.
6,654,740	B2	11/2003	Tokuda et al.
6,665,639	B2	12/2003	Mozer et al.
6,665,640	B1	12/2003	Bennett et al.
6,665,641	B1	12/2003	Coorman et al.
6,684,187	B1	1/2004	Conkie
6,691,064	B2	2/2004	Vroman
6,691,111	B2	2/2004	Lazaridis et al.
6,691,151	B1	2/2004	Cheyer et al.
6,697,780	B1	2/2004	Beutnagel et al.
6,697,824	B1	2/2004	Bowman-Amuah
6,701,294	B1	3/2004	Ball et al.
6,711,585	B1	3/2004	Copperman et al.
6,718,324	B2	4/2004	Edlund et al.
6,721,728	B2	4/2004	McGreevy
6,735,632	B1	5/2004	Kiraly et al.
6,742,021	B1	5/2004	Halverson et al.
6,757,362	B1	6/2004	Cooper et al.
6,757,718	B1	6/2004	Halverson et al.
6,766,320	B1	7/2004	Wang et al.
6,778,951	B1	8/2004	Contractor

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,778,952	B2	8/2004	Bellegarda	
6,778,962	B1	8/2004	Kasai et al.	
6,778,970	B2	8/2004	Au	
6,792,082	B1	9/2004	Levine	
6,807,574	B1	10/2004	Partovi et al.	
6,810,379	B1	10/2004	Vermeulen et al.	
6,813,491	B1	11/2004	McKinney	
6,829,603	B1	12/2004	Chai et al.	
6,832,194	B1	12/2004	Mozer et al.	
6,842,767	B1	1/2005	Partovi et al.	
6,847,966	B1	1/2005	Sommer et al.	
6,847,979	B2	1/2005	Allemang et al.	
6,851,115	B1	2/2005	Cheyer et al.	
6,859,931	B1	2/2005	Cheyer et al.	
6,895,380	B2	5/2005	Sepe, Jr.	
6,895,558	B1	5/2005	Loveland	
6,901,399	B1	5/2005	Corston et al.	
6,912,499	B1	6/2005	Sabourin et al.	
6,924,828	B1	8/2005	Hirsch	
6,928,614	B1	8/2005	Everhart	
6,931,384	B1	8/2005	Horvitz et al.	
6,934,684	B2	8/2005	Alpdemir et al.	
6,937,975	B1	8/2005	Elworthy	
6,937,986	B2	8/2005	Denenberg et al.	
6,964,023	B2	11/2005	Maes et al.	
6,980,949	B2	12/2005	Ford	
6,980,955	B2	12/2005	Okutani et al.	
6,985,865	B1	1/2006	Packingham et al.	
6,988,071	B1	1/2006	Gazdzinski	
6,996,531	B2	2/2006	Korall et al.	
6,999,927	B2	2/2006	Mozer et al.	
7,020,685	B1	3/2006	Chen et al.	
7,024,363	B1	4/2006	Comerford et al.	
7,027,974	B1	4/2006	Busch et al.	
7,036,128	B1	4/2006	Julia et al.	
7,050,977	B1	5/2006	Bennett	
7,058,569	B2	6/2006	Coorman et al.	
7,062,428	B2	6/2006	Hogenhout et al.	
7,069,560	B1	6/2006	Cheyer et al.	
7,092,887	B2	8/2006	Mozer et al.	
7,092,928	B1	8/2006	Elad et al.	
7,093,693	B1	8/2006	Gazdzinski	
7,127,046	B1	10/2006	Smith et al.	
7,127,403	B1	10/2006	Saylor et al.	
7,136,710	B1	11/2006	Hoffberg et al.	
7,137,126	B1	11/2006	Coffman et al.	
7,139,714	B2	11/2006	Bennett et al.	
7,139,722	B2	11/2006	Perrella et al.	
7,152,070	B1	12/2006	Musick et al.	
7,177,798	B2	2/2007	Hsu et al.	
7,197,460	B1	3/2007	Gupta et al.	
7,200,559	B2	4/2007	Wang	
7,203,646	B2	4/2007	Bennett	
7,216,073	B2	5/2007	Lavi et al.	
7,216,080	B2	5/2007	Tsiao et al.	
7,225,125	B2	5/2007	Bennett et al.	
7,233,790	B2	6/2007	Kjellberg et al.	
7,233,904	B2	6/2007	Luisi	
7,266,496	B2	9/2007	Wang et al.	
7,277,854	B2	10/2007	Bennett et al.	
7,290,039	B1	10/2007	Lisitsa et al.	
7,299,033	B2	11/2007	Kjellberg et al.	
7,310,600	B1	12/2007	Garner et al.	
7,324,947	B2	1/2008	Jordan et al.	
7,349,953	B2	3/2008	Lisitsa et al.	
7,376,556	B2	5/2008	Bennett	
7,376,645	B2	5/2008	Bernard	
7,379,874	B2	5/2008	Schmid et al.	
7,386,449	B2	6/2008	Sun et al.	
7,389,224	B1	6/2008	Elworthy	
7,392,185	B2	6/2008	Bennett	
7,398,209	B2	7/2008	Kennewick et al.	
7,403,938	B2	7/2008	Harrison et al.	
7,409,337	B1	8/2008	Potter et al.	
7,415,100	B2	8/2008	Cooper et al.	
7,418,392	B1	8/2008	Mozer et al.	
7,426,467	B2	9/2008	Nashida et al.	
7,427,024	B1	9/2008	Gazdzinski et al.	
7,447,635	B1	11/2008	Konopka et al.	
7,454,351	B2	11/2008	Jeschke et al.	
7,467,087	B1	12/2008	Gillick et al.	
7,475,010	B2	1/2009	Chao	
7,483,894	B2	1/2009	Cao	
7,487,089	B2	2/2009	Mozer	
7,496,498	B2	2/2009	Chu et al.	
7,496,512	B2	2/2009	Zhao et al.	
7,502,738	B2	3/2009	Kennewick et al.	
7,508,373	B2	3/2009	Lin et al.	
7,522,927	B2	4/2009	Fitch et al.	
7,523,108	B2	4/2009	Cao	
7,526,466	B2	4/2009	Au	
7,529,671	B2	5/2009	Rockenbeck et al.	
7,529,676	B2	5/2009	Koyama	
7,539,656	B2	5/2009	Fratkina et al.	
7,546,382	B2	6/2009	Healey et al.	
7,548,895	B2	6/2009	Pulsipher	
7,552,055	B2	6/2009	Lecoeuche	
7,555,431	B2	6/2009	Bennett	
7,558,730	B2	7/2009	Davis et al.	
7,571,106	B2	8/2009	Cao et al.	
7,599,918	B2	10/2009	Shen et al.	
7,620,549	B2	11/2009	Di Cristo et al.	
7,620,894	B1 *	11/2009	Kahn	G06F 3/0481 715/707
7,624,007	B2	11/2009	Bennett	
7,634,409	B2	12/2009	Kennewick et al.	
7,636,657	B2	12/2009	Ju et al.	
7,640,160	B2	12/2009	Di Cristo et al.	
7,647,225	B2	1/2010	Bennett et al.	
7,657,424	B2	2/2010	Bennett	
7,664,638	B2	2/2010	Cooper et al.	
7,672,841	B2	3/2010	Bennett	
7,676,026	B1	3/2010	Baxter, Jr.	
7,684,985	B2	3/2010	Dominach et al.	
7,693,715	B2	4/2010	Hwang et al.	
7,693,720	B2	4/2010	Kennewick et al.	
7,698,131	B2	4/2010	Bennett	
7,702,500	B2	4/2010	Blaedow	
7,702,508	B2	4/2010	Bennett	
7,703,091	B1 *	4/2010	Martin	G06F 8/61 717/172
7,707,027	B2	4/2010	Balchandran et al.	
7,707,032	B2	4/2010	Wang et al.	
7,707,267	B2	4/2010	Lisitsa et al.	
7,711,565	B1	5/2010	Gazdzinski	
7,711,672	B2	5/2010	Au	
7,716,056	B2	5/2010	Weng et al.	
7,720,674	B2	5/2010	Kaiser et al.	
7,720,683	B1	5/2010	Vermeulen et al.	
7,721,301	B2	5/2010	Wong et al.	
7,725,307	B2	5/2010	Bennett	
7,725,318	B2	5/2010	Gavalda et al.	
7,725,320	B2	5/2010	Bennett	
7,725,321	B2	5/2010	Bennett	
7,729,904	B2	6/2010	Bennett	
7,729,916	B2	6/2010	Coffman et al.	
7,734,461	B2	6/2010	Kwak et al.	
7,747,616	B2	6/2010	Yamada et al.	
7,752,152	B2	7/2010	Paek et al.	
7,756,868	B2	7/2010	Lee	
7,774,204	B2	8/2010	Mozer et al.	
7,783,486	B2	8/2010	Rosser et al.	
7,801,729	B2	9/2010	Mozer	
7,809,570	B2	10/2010	Kennewick et al.	
7,809,610	B2	10/2010	Cao	
7,818,176	B2	10/2010	Freeman et al.	
7,822,608	B2	10/2010	Cross, Jr. et al.	
7,826,945	B2	11/2010	Zhang et al.	
7,831,426	B2	11/2010	Bennett	
7,840,400	B2	11/2010	Lavi et al.	
7,840,447	B2	11/2010	Kleinrock et al.	
7,853,574	B2	12/2010	Kraenzel et al.	
7,853,664	B1	12/2010	Wang et al.	
7,873,519	B2	1/2011	Bennett	

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,873,654	B2	1/2011	Bernard
7,881,936	B2	2/2011	Longe et al.
7,890,652	B2	2/2011	Bull et al.
7,912,702	B2	3/2011	Bennett
7,917,367	B2	3/2011	Di Cristo et al.
7,917,497	B2	3/2011	Harrison et al.
7,920,678	B2	4/2011	Cooper et al.
7,925,525	B2	4/2011	Chin
7,930,168	B2	4/2011	Weng et al.
7,949,529	B2	5/2011	Weider et al.
7,949,534	B2	5/2011	Davis et al.
7,974,844	B2	7/2011	Sumita
7,974,972	B2	7/2011	Cao
7,983,915	B2	7/2011	Knight et al.
7,983,917	B2	7/2011	Kennewick et al.
7,983,997	B2	7/2011	Allen et al.
7,986,431	B2	7/2011	Emori et al.
7,987,151	B2	7/2011	Schott et al.
7,996,228	B2	8/2011	Miller et al.
8,000,453	B2	8/2011	Cooper et al.
8,005,679	B2	8/2011	Jordan et al.
8,015,006	B2	9/2011	Kennewick et al.
8,024,195	B2	9/2011	Mozer et al.
8,032,383	B1	10/2011	Bhardwaj et al.
8,036,901	B2	10/2011	Mozer
8,041,570	B2	10/2011	Mirkovic et al.
8,041,611	B2	10/2011	Kleinrock et al.
8,055,708	B2	11/2011	Chitsaz et al.
8,065,155	B1	11/2011	Gazdzinski
8,065,156	B2	11/2011	Gazdzinski
8,069,046	B2	11/2011	Kennewick et al.
8,073,681	B2	12/2011	Baldwin et al.
8,078,473	B1	12/2011	Gazdzinski
8,082,153	B2	12/2011	Coffman et al.
8,095,364	B2	1/2012	Longe et al.
8,099,289	B2	1/2012	Mozer et al.
8,107,401	B2	1/2012	John et al.
8,112,275	B2	2/2012	Kennewick et al.
8,112,280	B2	2/2012	Lu
8,117,037	B2	2/2012	Gazdzinski
8,131,557	B2	3/2012	Davis et al.
8,140,335	B2	3/2012	Kennewick et al.
8,165,886	B1	4/2012	Gagnon et al.
8,166,019	B1	4/2012	Lee et al.
8,190,359	B2	5/2012	Bourne
8,195,467	B2	6/2012	Mozer et al.
8,204,238	B2	6/2012	Mozer
8,205,788	B1	6/2012	Gazdzinski et al.
8,219,407	B1	7/2012	Roy et al.
8,285,551	B2	10/2012	Gazdzinski
8,285,553	B2	10/2012	Gazdzinski
8,290,778	B2	10/2012	Gazdzinski
8,290,781	B2	10/2012	Gazdzinski
8,296,146	B2	10/2012	Gazdzinski
8,296,153	B2	10/2012	Gazdzinski
8,296,383	B2	10/2012	Lindahl
8,301,456	B2	10/2012	Gazdzinski
8,311,834	B1	11/2012	Gazdzinski
8,370,158	B2	2/2013	Gazdzinski
8,371,503	B2	2/2013	Gazdzinski
8,374,871	B2	2/2013	Ehsani et al.
8,447,612	B2	5/2013	Gazdzinski
2001/0047264	A1	11/2001	Roundtree
2002/0010584	A1	1/2002	Schultz et al.
2002/0032564	A1	3/2002	Ehsani et al.
2002/0035474	A1	3/2002	Alpdemir
2002/0046025	A1	4/2002	Hain
2002/0069063	A1	6/2002	Buchner et al.
2002/0077817	A1	6/2002	Atal
2002/0103641	A1	8/2002	Kuo et al.
2002/0116185	A1	8/2002	Cooper et al.
2002/0116189	A1	8/2002	Yeh et al.
2002/0164000	A1	11/2002	Cohen et al.
2002/0198714	A1	12/2002	Zhou
2003/0088414	A1	5/2003	Huang et al.
2003/0097210	A1	5/2003	Horst et al.
2003/0135740	A1	7/2003	Talmor et al.
2004/0135701	A1	7/2004	Yasuda et al.
2004/0199387	A1	10/2004	Wang et al.
2004/0220798	A1	11/2004	Chi et al.
2004/0236778	A1	11/2004	Junqua et al.
2004/0260718	A1	12/2004	Fedorov
2005/0002507	A1	1/2005	Timmins et al.
2005/0055403	A1	3/2005	Brittan
2005/0071332	A1	3/2005	Ortega et al.
2005/0080625	A1	4/2005	Bennett et al.
2005/0091118	A1	4/2005	Fano
2005/0102614	A1	5/2005	Brockett et al.
2005/0108001	A1	5/2005	Aarskog
2005/0108642	A1	5/2005	Sinclair, II
2005/0114124	A1	5/2005	Liu et al.
2005/0119897	A1	6/2005	Bennett et al.
2005/0143972	A1	6/2005	Gopalakrishnan et al.
2005/0165607	A1	7/2005	Di Fabbrizio et al.
2005/0182629	A1	8/2005	Coorman et al.
2005/0196733	A1	9/2005	Budra et al.
2005/0273626	A1	12/2005	Pearson et al.
2005/0288936	A1	12/2005	Busayapongchai et al.
2006/0018492	A1	1/2006	Chiu et al.
2006/0106592	A1	5/2006	Brockett et al.
2006/0106594	A1	5/2006	Brockett et al.
2006/0106595	A1	5/2006	Brockett et al.
2006/0117002	A1	6/2006	Swen
2006/0122834	A1	6/2006	Bennett
2006/0143007	A1	6/2006	Koh et al.
2006/0217967	A1	9/2006	Goertzen et al.
2006/0235700	A1	10/2006	Wong et al.
2007/0041361	A1	2/2007	Iso-Sipila
2007/0055529	A1	3/2007	Kanevsky et al.
2007/0058832	A1	3/2007	Hug et al.
2007/0088556	A1	4/2007	Andrew
2007/0100790	A1	5/2007	Cheyer et al.
2007/0106674	A1	5/2007	Agrawal et al.
2007/0118377	A1	5/2007	Badino et al.
2007/0135949	A1	6/2007	Snover et al.
2007/0174188	A1	7/2007	Fish
2007/0185917	A1	8/2007	Prahlad et al.
2007/0282595	A1	12/2007	Tunning et al.
2008/0015864	A1	1/2008	Ross et al.
2008/0021708	A1	1/2008	Bennett et al.
2008/0034032	A1	2/2008	Healey et al.
2008/0052063	A1	2/2008	Bennett et al.
2008/0082332	A1	4/2008	Mallett et al.
2008/0082338	A1	4/2008	O'Neil et al.
2008/0120112	A1	5/2008	Jordan et al.
2008/0129520	A1	6/2008	Lee
2008/0140416	A1	6/2008	Shostak
2008/0140657	A1	6/2008	Azvine et al.
2008/0161113	A1*	7/2008	Hansen A63F 13/12 463/42
2008/0221903	A1	9/2008	Kanevsky et al.
2008/0228496	A1	9/2008	Yu et al.
2008/0247519	A1	10/2008	Abella et al.
2008/0249770	A1	10/2008	Kim et al.
2008/0256613	A1	10/2008	Grover
2008/0300878	A1	12/2008	Bennett
2008/0319763	A1	12/2008	Di Fabbrizio et al.
2009/0006100	A1	1/2009	Badger et al.
2009/0006343	A1	1/2009	Platt et al.
2009/0018835	A1	1/2009	Cooper et al.
2009/0030800	A1	1/2009	Grois
2009/0055179	A1	2/2009	Cho et al.
2009/0058823	A1	3/2009	Kocienda
2009/0076796	A1	3/2009	Daraselia
2009/0077165	A1	3/2009	Rhodes et al.
2009/0100049	A1	4/2009	Cao
2009/0112677	A1	4/2009	Rhett
2009/0150156	A1	6/2009	Kennewick et al.
2009/0157401	A1	6/2009	Bennett
2009/0164441	A1	6/2009	Cheyer
2009/0171664	A1	7/2009	Kennewick et al.
2009/0204409	A1	8/2009	Mozer et al.
2009/0287583	A1	11/2009	Holmes
2009/0290718	A1	11/2009	Kahn et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0299745	A1	12/2009	Kennewick et al.	
2009/0299849	A1	12/2009	Cao et al.	
2009/0307162	A1	12/2009	Bui et al.	
2010/0005081	A1	1/2010	Bennett	
2010/0023320	A1	1/2010	Di Cristo et al.	
2010/0036660	A1	2/2010	Bennett	
2010/0042400	A1	2/2010	Block et al.	
2010/0088020	A1	4/2010	Sano et al.	
2010/0088100	A1	4/2010	Lindahl	
2010/0131273	A1	5/2010	Aley-Raz et al.	
2010/0138215	A1	6/2010	Williams	
2010/0145700	A1	6/2010	Kennewick et al.	
2010/0204986	A1	8/2010	Kennewick et al.	
2010/0217604	A1	8/2010	Baldwin et al.	
2010/0228540	A1	9/2010	Bennett	
2010/0235341	A1	9/2010	Bennett	
2010/0257160	A1	10/2010	Cao	
2010/0262599	A1	10/2010	Nitz	
2010/0277579	A1	11/2010	Cho et al.	
2010/0278320	A1	11/2010	Arsenault et al.	
2010/0280983	A1	11/2010	Cho et al.	
2010/0286985	A1	11/2010	Kennewick et al.	
2010/0299142	A1	11/2010	Freeman et al.	
2010/0312547	A1	12/2010	Van Os et al.	
2010/0318576	A1	12/2010	Kim	
2010/0332235	A1	12/2010	David	
2010/0332348	A1	12/2010	Cao	
2011/0047072	A1	2/2011	Ciurea	
2011/0060807	A1	3/2011	Martin et al.	
2011/0082688	A1	4/2011	Kim et al.	
2011/0112827	A1	5/2011	Kennewick et al.	
2011/0112921	A1	5/2011	Kennewick et al.	
2011/0119049	A1	5/2011	Ylonen	
2011/0125540	A1	5/2011	Jang et al.	
2011/0130958	A1	6/2011	Stahl et al.	
2011/0131036	A1	6/2011	DiCristo et al.	
2011/0131045	A1	6/2011	Cristo et al.	
2011/0143811	A1	6/2011	Rodriguez	
2011/0144999	A1	6/2011	Jang et al.	
2011/0161076	A1	6/2011	Davis et al.	
2011/0161309	A1	6/2011	Lung et al.	
2011/0175810	A1	7/2011	Markovic et al.	
2011/0184730	A1	7/2011	LeBeau et al.	
2011/0218855	A1	9/2011	Cao et al.	
2011/0231182	A1	9/2011	Weider et al.	
2011/0231188	A1	9/2011	Kennewick et al.	
2011/0264643	A1	10/2011	Cao	
2011/0279368	A1	11/2011	Klein et al.	
2011/0283189	A1*	11/2011	McCarty	H04N 5/44543 715/707
2011/0298585	A1	12/2011	Barry	
2011/0306426	A1	12/2011	Novak et al.	
2012/0002820	A1	1/2012	Leichter	
2012/0016678	A1	1/2012	Gruber et al.	
2012/0020490	A1	1/2012	Leichter	
2012/0022787	A1	1/2012	LeBeau et al.	
2012/0022857	A1	1/2012	Baldwin et al.	
2012/0022860	A1	1/2012	Lloyd et al.	
2012/0022868	A1	1/2012	LeBeau et al.	
2012/0022869	A1	1/2012	Lloyd et al.	
2012/0022870	A1	1/2012	Kristjansson et al.	
2012/0022874	A1	1/2012	Lloyd et al.	
2012/0022876	A1	1/2012	LeBeau et al.	
2012/0023088	A1	1/2012	Cheng et al.	
2012/0034904	A1	2/2012	LeBeau et al.	
2012/0035908	A1	2/2012	LeBeau et al.	
2012/0035924	A1	2/2012	Jitkoff et al.	
2012/0035931	A1	2/2012	LeBeau et al.	
2012/0035932	A1	2/2012	Jitkoff et al.	
2012/0042343	A1	2/2012	Laligand et al.	
2012/0075054	A1*	3/2012	Ge	G05B 19/0426 340/3.1
2012/0137367	A1	5/2012	Dupont et al.	
2012/0173464	A1	7/2012	Tur et al.	
2012/0254290	A1*	10/2012	Naaman	G06Q 20/407 709/203
2012/0265528	A1	10/2012	Gruber et al.	
2012/0271676	A1	10/2012	Aravamudan et al.	
2012/0296654	A1*	11/2012	Hendrickson	G10L 13/02 704/260
2012/0311583	A1	12/2012	Gruber et al.	
2012/0330661	A1	12/2012	Lindahl	
2013/0006638	A1	1/2013	Lindahl	
2013/0110518	A1	5/2013	Gruber et al.	
2013/0110520	A1	5/2013	Cheyer et al.	
2014/0223377	A1*	8/2014	Shaw	G06F 3/04847 715/835

FOREIGN PATENT DOCUMENTS

DE	19841541	B4	12/2007
EP	0138061	A1	4/1985
EP	0218859	A2	4/1987
EP	0262938	A1	4/1988
EP	0138061	B1	6/1988
EP	0293259	A2	11/1988
EP	0299572	A2	1/1989
EP	0313975	A2	5/1989
EP	0314908	A2	5/1989
EP	0327408	A2	8/1989
EP	0389271	A2	9/1990
EP	0411675	A2	2/1991
EP	0559349	A1	9/1993
EP	0570660	A1	11/1993
EP	0863453	A1	9/1998
EP	0559349	B1	1/1999
EP	1229496	A2	8/2002
EP	1245023	A1	10/2002
EP	2109295	A1	10/2009
GB	2293667	A	4/1996
JP	6-19965	A	1/1994
JP	2001-125896	A	5/2001
JP	2002-24212	A	1/2002
JP	2003-517158	A	5/2003
JP	2009-36999	A	2/2009
KR	10-0757496	B1	9/2007
KR	10-0776800	B1	11/2007
KR	10-0801227	B1	2/2008
KR	10-0810500	B1	3/2008
KR	10-2008-0109322	A	12/2008
KR	10-2009-0086805	A	8/2009
KR	10-0920267	B1	10/2009
KR	10-2010-0119519	A	11/2010
KR	10-1032792	B1	5/2011
KR	10-2011-0113414	A	10/2011
WO	95/02221	A1	1/1995
WO	97/26612	A1	7/1997
WO	98/41956	A1	9/1998
WO	99/01834	A1	1/1999
WO	99/08238	A1	2/1999
WO	99/56227	A1	11/1999
WO	00/60435	A2	10/2000
WO	00/60435	A3	4/2001
WO	02/073603	A1	9/2002
WO	2006/129967	A1	12/2006
WO	2008/085742	A2	7/2008
WO	2008/109835	A2	9/2008
WO	2010/075623	A1	7/2010
WO	2011/088053	A2	7/2011
WO	2012/155079	A2	11/2012

OTHER PUBLICATIONS

Jonathan Wolf, the Next Step in Routing Configuration, Mar. 2001, Boardwatch Magazine, vol. 15, pp. 44-48.*

Lieberman et al., "Out of Context: Computer Systems that Adapt to, and Learn from, Context", IBM Systems Journal, vol. 39, No. 3&4, 2000, pp. 617-632.

Lin et al., "A Distributed Architecture for Cooperative Spoken Dialogue Agents with Coherent Dialogue State and History", <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=1 0.1.1.42.272>, 1999, 4 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Lin et al., "A New Framework for Recognition of Mandarin Syllables With Tones Using Sub-syllabic Units", IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP-93), Apr. 27-30, 1993, pp. 227-230.
Linde, "An Algorithm for Vector Quantizer Design", IEEE Transactions on Communications, vol. 28, No. 1, Jan. 1980, pp. 84-95.
Liu et al., "Efficient Joint Compensation of Speech for the Effects of Additive Noise and Linear Filtering", IEEE International Conference of Acoustics, Speech, and Signal Processing,ICASSP-92, Mar. 23-26, 1992, pp. 257-260.
Lntraspect Software, "The Intraspect Knowledge Management Solution: Technical Overview", <http://tomgruber.org/writing/intraspect-whitepaper-1998.pdf>, 1998, 18 pages.
Logan et al., "Mel Frequency Cepstral Coefficients for Music Modeling", In International Symposium on Music Information Retrieval, 2000, 2 pages.
Lowegian International, "FIR Filter Properties", dspGuro, Digital Signal Processing Central, available online at <httJ;>://www.dspQuru.com/dso/taas/fir/orooerties, > retrived from internet on Jul. 28, 2010, 6 pages.
Lowerre, B. T., "The-HARPY Speech Recognition System", Doctoral Dissertation, Department of Computer Science, Carnegie Mellon University, Apr. 1976, 20 pages.
Maghbouleh, A., "An Empirical Comparison of Automatic Decision Tree and Linear Regression Models for Vowel Durations", Revised Version of a Paper Presented at the Computational Phonology in Speech Technology workshop, 1996 annual meeting of the Association for Computational Linguistics in Santa Cruz, California, 7 pages.
Markel et al., "Linear Prediction of Speech", Springer-Verlag, Berlin Heidelberg New York, 1976, 12 pages.
Martin et al., "The Open Agent Architecture: A Framework for Building Distributed Software Systems", Applied Artificial Intelligence: An International Journal, vol. 13, No. 1-2, pp. 1-38.
Martin et al., "Building and Using Practical Agent Applications", SRI International, PAAM Tutorial, 1998, pp. 1-26.
Martin et al., "Building Distributed Software Systems with the Open Agent Architecture", Proceedings of the Third International Conference on the Practical Application of Intelligent Agents and Multi-Agent Technology, Mar. 23-25, 1998, pp. 355-376.
Martin et al., "Development Tools for the Open Agent Architecture", Proceedings of the International Conference on the Practical Application of Intelligent Agents and Multi-Agent Technology, Apr. 1996, pp. 1-17.
Martin et al., "Information Brokering in an Agent Architecture", Proceedings of the second International Conference on the Practical Application of Intelligent Agents and Multi-Agent Technology, Apr. 1997, pp. 1-20.
Martin et al., "Transportability and Generality in a Natural-Language Interface System", Proceedings of the Eight International Joint Conference on Artificial Intelligence, Technical Note 293, Aug. 8-12, 1983, 21 pages.
Matiasek et al., "Tamic-P: A System for NL Access to Social Insurance Database", 4th International Conference on Applications of Natural Language to Information Systems, Jun. 17-19, 1999, 7 pages.
McGuire et al., "SHADE: Technology for Knowledge-Based Collaborative Engineering", Journal of Concurrent Engineering~r Applications and Research (CERA), 1993, 18 pages.
Meng et al., "Wheels: A Conversational System in the Automobile Classified Domain", Proceedings Fourth International Conference on Spoken Language, 1996. ICSLP 96, Oct. 1996, pp. 542-545.
Michos et al., "Towards an Adaptive Natural Language Interface to Command Languages", Natural Language Engineering, vol. 2, No. 3, 1996, pp. 191-209.
Milstead et al., "Metadata: Cataloging by Any Other Name", Online, Information Today, Inc., Jan. 1999, 18 pages.
Milward et al., "D2.2: Dynamic MultimodalInterface Reconfiguration" Talk and Look: Tools for Ambient Linguistic Knowledge, IST-507802 Deliverable D2.2, Aug. 8, 2006, 69 pages.
Minker et al., "Hidden Understanding Models for Machine Translation", Proceedings of ETRW on Interactive Dialogue in Multi-Modal Systems, Jun. 1999, pp. 1-4.
Mitra et al., "A Graph-Oriented Model for Articulation of Ontology Interdependencies", Lecture Notes in Computer Science, vol. 1777, 2000, pp. 86-100.
Modi et al., "CMRadar: A Personal Assistant Agent for Calendar Management", AAAI, Intelligent Systems Demonstrations, 2004, pp. 1020-1021.
Moore et al., "Combining Linguistic and Statistical Knowledge Sources in Natural-Language Processing for ATIS", SRI International, ArtificialIntelliqence Center, 1995, 4 pages.
Moore et al., "SRI's Experience with the ATIS Evaluation", Proceedings of the workshop on Speech and Natural Language, Jun. 24-27, 1990, pp. 147-148.
Moore et al., "The Information Warefare Advisor: An Architecture for Interacting with Intelligent Agents Across the Web", Proceedings of Americas Conference on Information Systems (AMCIS), Dec. 31, 1998, pp. 186-188.
Moore, Robert C., "Handling Complex Queries in a Distributed Data Base", SRI International, Technical Note 170, Oct. 8, 1979, 38 pages.
Moore, Robert C., "Practical Natural-Language Processing by Computer", SRI International, Technical Note 251, Oct. 1981, 34 pages.
Moore, Robert C., "The Role of Logic in Knowledge Representation and Commonsense Reasoning", SRI International, Technical Note 264, Jun. 1982, 19 pages.
Moore, Robert C., "Using Natural-Language Knowledge Sources in Speech Recognition", SRI International, Artificial Intelligence Center, Jan. 1999, pp. 1-24.
Moran et al., "Intelligent Agent-based User Interfaces", Proceedings of International Workshop on Human Interface Technology, Oct. 12-13, 1995, pp. 1-4.
Moran et al., "Multimodal User Interfaces in the Open Agent Architecture", International Conference on Intelligent User Interfaces (IUI97), 1997, 8 pages.
Moran, Douglas B., "Quantifier Scoping in the SRI Core Language Engine", Proceedings of the 26th Annual Meeting on Association for Computational Linguistics, 1988, pp. 33-40.
Morgan, B., "Business Objects (Business Objects for Windows) Business Objects Inc.", DBMS, vol. 5, No. 10, Sep. 1992, 3 pages.
Motro, Amihai, "Flex: A Tolerant and Cooperative User Interface to Databases", IEEE Transactions on Knowledge and Data Engineering, vol. 2, No. 2, Jun. 1990, pp. 231-246.
Mountford et al., "Talking and Listening to Computers", The Art of Human-Computer Interface Design, Copyright © 1990 Apple Computer, Inc. Addison-Wesley Publishing Company, Inc, 1990, 17 pages.
Mozer, Michael C., "An Intelligent Environment Must be Adaptive", IEEE Intelligent Systems, Mar./Apr. 1999, pp. 11-13.
Muhlhauser, Max, "Context Aware Voice User Interfaces for Workflow Support", 2007, 254 pages.
Murty, "Combining Evidence from Residual Phase and MFCC Features for Speaker Recognition", IEEE Signal Processing Letters, vol. 13, No. 1, Jan. 2006, pp. 52-55.
Murveit et al., "Integrating Natural Language Constraints into HMM-based Speech Recognition", 1990 International Conference on Acoustics, Speech, and Signal Processing, Apr. 3-6, 1990, 5 pages.
Murveit et al., "Speech Recognition in SRI's Resource Management and ATIS Systems", Proceedings of the Workshop on Speech and Natural Language, 1991, pp. 94-100.
Nakagawa et al., "Speaker Recognition by Combining MFCC and Phase Information", IEEE International Conference on Acoustics Speech and Signal Processing ICASSP, Mar. 14-19, 2010, pp. 4502-4505.
Naone, Erica, "TR10: Intelligent Software Assistant", Technology Review, Mar.-Apr. 2009, 2 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Neches et al., "Enabling Technology for Knowledge Sharing", Fall, 1991, pp. 37-56.
Niesler et al., "A Variable-Length Category-Based N-Gram Language Model", IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP'96), vol. 1, May 7-10, 1996, pp. 164-167.
Noth et al., "Verbmobil: The Use of Prosody in the Linguistic Components of a Speech Understanding System", IEEE Transactions on Speech and Audio Processing, vol. 8, No. 5, Sep. 2000, pp. 519-532.
Odubiyi et al., "SAIRE—A Scalable Agent-Based Information Retrieval Engine", Proceedings of the First International Conference on Autonomous Agents, 1997, 12 pages.
Bahl et al., "Multonic Markov Word Models for Large Vocabulary Continuous Speech Recognition", IEEE Transactions on Speech and Audio Processing, vol. 1, No. 3, Jul. 1993, 11 pages.
Bahl et al., "Speech Recognition with Continuous-Parameter Hidden Markov Models", In Proceeding of International Conference on Acoustics, Speech, and Signal Processing (ICASSP'88), vol. 1, Apr. 11-14, 1988, 8 pages.
Banbrook, M., "Nonlinear Analysis of Speech from a Synthesis Perspective", A Thesis Submitted for the Degree of Doctor of Philosophy, The University of Edinburgh, Oct. 15, 1996, 35 pages.
Bear et al., "A System for Labeling Self-Repairs in Speech", SRI International, Technical Note 522, Feb. 22, 1993, pp. 1-8.
Bear et al., "Detection and Correction of Repairs in Human-Computer Dialog", SRI International, Technical Note 518, May 5, 1992, pp. 1-10.
Bear et al., "Integrating Multiple Knowledge Sources for Detection and Correction of Repairs in Human-Computer Dialog", Proceedings of the 30th annual meeting on Association for Computational Linguistics (ACL), 1992, 8 pages.
Bear et al., "Using Information Extraction to Improve Document Retrieval", SRI International, Jan. 9, 1998, pp. 1-11.
Belaid et al., "A Syntactic Approach for Handwritten Mathematical Formula Recognition", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. PAMI-6, No. 1, Jan. 1984, 7 pages.
Bellegarda et al., "A Latent Semantic Analysis Framework for Large-Span Language Modeling", 5th European Conference on Speech, Communication and Technology, (EUROSPEECH'97), Sep. 22-25, 1997, 4 pages.
Bellegarda et al., "A Multispan Language Modeling Framework for Large Vocabulary Speech Recognition", IEEE Transactions on Speech and Audio Processing vol. 6, No. 5, Sep. 1998, 12 pages.
Bellegarda et al., "A Novel Word Clustering Algorithm Based on Latent Semantic Analysis", In Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP'96}, vol. 1, 1996, 4 pages.
Bellegarda et al., "Experiments Using Data Augmentation for Speaker Adaptation", International Conference on Acoustics, Speech, and Signal Processing (ICASSP'95), May 9-12, 1995, 4 pages.
Bellegarda et al., "On-Line Handwriting Recognition Using Statistical Mixtures", Advances in Handwriting and Drawings: A Multidisciplinary Approach, Europia, 6th International IGS Conference on Handwriting and Drawing, Paris-France, Jul. 1993, 11 pages.
Bellegarda et al., "Performance of the IBM Large Vocabulary Continuous Speech Recognition System on the ARPA Wall Street Journal Task", Signal Processing VII: Theories and Applications, © 1994 European Association for Signal Processing, 1994, 4 pages.
Bellegarda et al., "The Metamorphic Algorithm: A Speaker Mapping Approach to Data Augmentation", IEEE Transactions on Speech and Audio Processing, vol. 2, No. 3, Jul. 1994, 8 pages.
Bellegarda, J. R., "Exploiting Both Local and Global Constraints for Multi-Span Statistical Language Modeling", Proceeding of the 1998 IEEE International Conference on Acoustics, Speech, and Signal Processing (1CASSP'98), vol. 2, May 12-15, 1998, 5 pages.
Bellegarda, J. R., "Exploiting Latent Semantic Information in Statistical Language Modeling", Proceedings of the IEEE, vol. 88, No. 8, Aug. 2000, 18 pages.
Bellegarda, J. R., "Interaction-Driven Speech Input—A Data-Driven Approach to the Capture of Both Local and Global Language Constraints", available online at <http:// old.sig.chi.ora/bulletin/ 1998.2/bellegarda.html>, 1992, 7 pages.
Bellegarda, J. R., "Large Vocabulary Speech Recognition with Multispan Statistical Language Models", IEEE Transactions on Speech and Audio Processing, vol. 8, No. 1, Jan. 2000, 9 pages.
Belvin et al., "Development of the HRL Route Navigation Dialogue System", In Proceedings of the First International Conference on Human Language Technology Research, Paper, 2001, 5 pages.
Berry et al., "PTIME: Personalized Assistance for Calendaring", ACM Transactions on Intelligent Systems and Technology, vol. 2, No. 4, Article 40, Jul. 2011, pp. 1-22.
Berry et al., "Task Management under Change and Uncertainty Constraint Solving Experience with the CALO Project", Proceedings of CP'05 Workshop on Constraint Solving under Change, 2005, 5 pages.
Black et al., "Automatically Clustering Similar Units for Unit Selection in Speech Synthesis", In Proceedings of Eurospeech 1997, vol. 2, 1997, 4 pages.
Blair et al., "An Evaluation of Retrieval Effectiveness for a Full-Text Document-Retrieval System", Communications of the ACM, vol. 28, No. 3, Mar. 1985, 11 pages.
Bobrow et al., "Knowledge Representation for Syntactic/Semantic Processing", AAA-80 Proceedings, 1980, pp. 316-323.
Bouchou et al., "Using Transducers in Natural Language Database Query", Proceedings of 4th International Conference on Applications of Natural Language to Information Systems, Austria, Jun. 17-19, 1999, 17 pages.
Bratt et al., "The SRI Telephone-based ATIS System", Proceedings of ARPA Workshop on Spoken Language Technology, 1995, 3 pages.
Briner, L. L., "Identifying Keywords in Text Data Processing", In Zelkowitz, Marvin V., ED, Directions and Challenges, 15th Annual Technical Symposium, Gaithersbury, Maryland, Jun. 17, 1976, 7 pages.
Bulyko et al., "Joint Prosody Prediction and Unit Selection for Concatenative Speech Synthesis", Electrical Engineering Department, University of Washington, Seattle, 2001, 4 pages.
Burke et al., "Question Answering from Frequently Asked Question Files", AI Magazine, Spring, vol. 18, No. 2, 1997, pp. 57-66.
Burns et al., "Development of a Web-Based Intelligent Agent for the Fashion Selection and Purchasing Process via Electronic Commerce", Proceedings of the Americas Conference on Information system (AMCIS), Dec. 31, 1998, pp. 140-142.
Bussey et al., "Service Architecture, Prototype Description, and Network Implications of a Personalized Information Grazing Service", INFOCOM'90, Ninth Annual Joint Conference of the IEEE Computer and Communication Societies, available online at <http:// slrohall.com/oublications/>, Jun. 3-7, 1990, 8 pages.
Bussler et al., "Web Service Execution Environment (WSMX)", available online at <http://www.w3.org/Submission/WSMX/>, retrieved from internet on Sep. 17, 2012, 29 pages.
Butcher, Mike, "EVI Arrives in Town to go Toe-to-Toe with Siri", TechCrunch, Jan. 23, 2012, 2 pages.
Buzo et al., "Speech Coding Based Upon Vector Quantization", IEEE Transactions on Acoustics, Speech, and Signal Processing, vol. Assp-28, No. 5, Oct. 1980, 13 pages.
Caminero-Gil et al., "Data-Driven Discourse Modeling for Semantic Interpretation", In Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing, May 7-10, 1996, 6 pages.
Carter et al., "The Speech-Language Interface in the Spoken Language Translator", SRI International, Nov. 23, 1994, pp. 1-9.
Carter, David M., "Lexical Acquisition in the Core Language Engine", Proceedings of the Fourth Conference of the European Chapter of the Association for Computational Linguistics, 1989, pp. 137-144.
Cawley, "The Application of Neural Networks to Phonetic Modelling", PhD Thesis, University of Essex, Mar. 1996, 13 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Chai et al., "Comparative Evaluation of a Natural Language Dialog Based System and a Menu Driven System for Information Access: a Case Study", Proceedings of the International Conference on Multimedia Information Retrieval (RIAO), Apr. 2000, 11 pages.
Chang et al., "A Segment-based Speech Recognition System for Isolated Mandarin Syllables", Proceedings TEN CON '93, IEEE Region 10 conference on Computer, Communication, Control and Power Engineering, vol. 3, Oct. 19-21, 1993, pp. 317-320.
Chen, Yi, "Multimedia Siri Finds and Plays Whatever You Ask For", PSFK Report, Feb. 9, 2012, 9 pages.
Cheyer et al., "Demonstration Video of Multimodal Maps Using an Agent Architecture", available online at <http://www.youtube.com/watch?v=x3TptMGT9EQ&feature=youtu.be>, published on 1996, 6 pages.
Cheyer et al., "Demonstration Video of Multimodal Maps Using an Open-Agent Architecture", available online at <http://www.youtube.com/watch?v=JUxaKnyZyM&feature=youtu.be>, published on 1996, 6 pages.
Cheyer et al., "Multimodal Maps: An Agent-based Approach", International Conference on Cooperative Multimodal Communication, Jun. 9, 1995, pp. 1-15.
Cheyer et al., "Spoken Language and Multimodal Applications for Electronic Realties", Virtual Reality, vol. 3, 1999, pp. 1-15.
Cheyer et al., "The Open Agent Architecture,", Autonomous Agents and Multi-Agent systems, vol. 4, Mar. 1, 2001, 6 pages.
Cheyer et al., "The Open Agent Architecture: Building Communities of Distributed Software Agents", Artificial Intelligence Center SRI International, Power Point presentation, available online at <http://www.ai.sri.com/~oaa>, Feb. 21, 1998, 25 pages.
Cheyer, A., "Demonstration Video of Vanguard Mobile Portal", available online at <http://www.youtube.com/watch?v=ZTMsvg_0oLQ&feature=youtu.be>, published on 2004, 10 pages.
Cheyer, Adam, "A Perspective on AI & Agent Technologies for SCM", VerticaiNet presentation, 2001, 22 pages.
Ward et al., "Recent Improvements in the CMU Spoken Language Understanding System", ARPA Human Language Technology Workshop, 1994, pp. 213-216.
Ward, Wayne, "The CMU Air Travel Information Service: Understanding Spontaneous Speech", Proceedings of the Workshop on Speech and Natural Language, HLT '90, 1990, pp. 127-129.
Warren, "An Efficient Easily Adaptable System for Interpreting Natural Language Queries", American Journal of Computational Linguistics, vol. 8, No. 3-4, Jul.-Dec. 1982, pp. 110-119.
Weizenbaum, Joseph, "ELIZA—A Computer Program for the Study of Natural Language Communication Between Man and Machine", Communications of the ACM, vol. 9, No. 1, Jan. 1966, pp. 36-45.
Werner et al., "Prosodic Aspects of Speech," Universite de Lausanne, Switzerland, 1994, Fundamentals of Speech Synthesis and Speech Recognition: Basic Concepts, State of the Art, and Future Challenges, 1994, pp. 23-40.
Winiwarter et al., "Adaptive Natural Language Interfaces to FAQ Knowledge Bases", Proceedings of 4th International Conference on Applications of Natural Language to Information Systems, Austria, Jun. 17-19, 1999, 22 pages.
Wolff, Mark, "Poststructuralism and the ARTFUL Database: Some Theoretical Considerations", Information Technology and Libraries, vol. 13, No. 1, Mar. 1994, 10 pages.
Wu et al., "KDA: A Knowledge-based Database Assistant", Data Engineering, Proceeding of the Fifth International Conference on Engineering (IEEE Cat No. 89CH2695-5), Feb. 6-10, 1989, pp. 402-409.
Wu, Min, "Digital Speech Processing and Coding", ENEE408G Capstone-Multimedia Signal Processing, Spring 2003, Lecture-2 Course Presentation, University of Maryland, College Park, 2003, pp. 1-8.
Wu, Min, "Speech Recognition, Synthesis, and H.C.I.", ENEE408G Capstone-Multimedia Signal Processing, Spring 2003, Lecture-3 course presentation, University of Maryland, College Park, 2003, pp. 1-11.
Wyle, M. F., "A Wide Area Network Information Filter", In Proceedings of First International Conference on Artificial Intelligence on Wall Street, Oct. 9-11, 1991, pp. 10-15.
Yang et al., "Smart Sight: A Tourist Assistant System", Proceedings of Third International Symposium on Wearable Computers, 1999, 6 pages.
Yankelovich et al., "Intermedia: The Concept and the Construction of a Seamless Information Environment", IEEE Computer Magazine, Jan. 1988, pp. 81-96.
Yoon et al., "Letter-to-Sound Rules for Korean", Department of Linguistics, The Ohio State University, 2002, 4 pages.
Zeng et al., "Cooperative Intelligent Software Agents", The Robotics Institute, Carnegie-Mellon University, Mar. 1995,13 pages.
Zhao Leon., "Intelligent Agents for Flexible Workflow Systems", Proceedings of the Americas Conference on Information Systems (AMCIS), 1998, pp. 237-239.
Zhao, Y., "An Acoustic-Phonetic-Based Speaker Adaptation Technique for Improving Speaker-Independent Continuous Speech Recognition", IEEE Transactions on Speech and Audio Processing, vol. 2, No. 3, Jul. 1994, pp. 380-394.
Zovato et al., "Towards Emotional Speech Synthesis: A Rule based Approach", Proceedings 5th ISCA Speech Synthesis Workshop—Pittsburgh, 2004, pp. 219-220.
Zue et al., "From Interface to Content: Translingual Access and Delivery of On-Line Information", EUROSPEECH, 1997, 4 pages.
Zue et al., "Jupiter: A Telephone-Based Conversational Interface for Weather Information", IEEE Transactions on Speech and Audio Processing, Jan. 2000, pp. 100-112.
Zue et al., "Pegasus: A Spoken Dialogue Interface for On-Line Air Travel Planning", Elsevier, Speech Communication, vol. 15, 1994, 10 pages.
Zue et al., "The Voyager Speech Understanding System: Preliminary Development and Evaluation", Proceedings of IEEE 1990 International Conference on Acoustics, Speech, and Signal Processing, 1990, pp. 73-76.
Zue, Victor, "Conversational Interfaces: Advances and Challenges", Spoken Language System Group <http://www.cs.cmu.edu/-dod/papers/zue97.pdf>, Sep. 1997, 10 pages.
Zue, Victor W., "Toward Systems that Understand Spoken Language", ARPA Strategic Computing Institute, Feb. 1994, pp. 51-59.
Grosz et al., "Research on Natural-Language Processing at SRI", SRI International Technical Note 257, Nov. 1981, 21 pages.
Grosz et al., "TEAM: An Experiment in the Design of Transportable Natural-Language Interfaces", Artificial Intelligence, vol. 32, 1987, pp. 173-243.
Grosz, Barbara J., "Team: A Transportable Natural-Language Interface System", Proceedings of the First Conference on Applied Natural Language Processing, 1983, pp. 39-45.
Gruber et al., "An Ontology for Engineering Mathematics", Fourth International Conference on Principles of Knowledge Representation and Reasoning, Available at <http://www-ksl.stanford.edu/knowledge-sharing/papers/engmath.html>, 1994, pp. 1-22.
Gruber et al., "Generative Design Rationale: Beyond the Record and Replay Paradigm", Knowledge Systems Laboratory, Technical Report KSL 92-59, Dec. 1991, Updated Feb. 1993, 24 pages.
Gruber et al., "Machine-Generated Explanations of Engineering Models: A Compositional Modeling Approach", In Proc. International Joint Conference on Artificial Intelligence, 1993, 7 pages.
Gruber et al., "NIKE: A National Infrastructure for Knowledge Exchange", A Whitepaper Advocating and ATP Initiative on Technologies for Lifelong Learning, Oct. 1994, pp. 1-10.
Gruber et al., "Toward a Knowledge Medium for Collaborative Product Development", Proceedings of the Second International Conference on Artificial Intelligence in Design, Jun. 22-25, 1992, pp. 1-19.
Gruber et al., "A Translation Approach to Portable Ontology Specifications", Knowledge Systems Laboratory, Technical Report KSL 92-71, Sep. 1992, Revised Apr. 1993, 27 pages.
Gruber, Thomas R., "Automated Knowledge Acquisition for Strategic Knowledge", Machine Learning, vol. 4, 1989, pp. 293-336.

(56) **References Cited**

OTHER PUBLICATIONS

Gruber, Thomas R., Interactive Acquisition of Justifications: Learning "Why" by Being Told "What", Knowledge Systems Laboratory, Technical Report KSL 91-17, Original Oct. 1990, Revised Feb. 1991, pp. 1-23.
Gruber, Thomas R., "Toward Principles for the Design of Ontologies Used for Knowledge Sharing", In International Journal Human-Computer Studies, vol. 43, p. 907-928, substantial revision of paper presented at the International Workshop on Formal Ontology, Available as Technical Report KSL 93-04, Knowledge Systems Laboratory, revised Aug. 23, 1993, 23 pages.
Gruber, Tom, "(Avoiding) the Travesty of the Commons", Presentation at NPUC, New Paradigms for User Computing, IBM Almaden Research Center, Jul. 24, 2006, 52 pages.
Gruber, Tom, "2021: Mass Collaboration and the Really New Economy", TNTY Futures, vol. 1, No. 6, Available Online at <http://tomgruber.org/writing/tnty2001.htm>, Aug. 2001, 5 pages.
Gruber, Tom, "Big Think Small Screen: How Semantic Computing in the Cloud will Revolutionize the Consumer Experience on the Phone", Keynote presentation at Web 3.0 conference, 2009, 41 pages.
Gruber, Tom, "Collaborating around Shared Content on the WWW", W3C Workshop on WWW and Collaboration, Available at <http://www.w3.org/Collaboration/Workshop/Proceedings/P9.html>, Sep. 11, 1995, 1 page.
Gruber, Tom, "Collective Knowledge Systems: Where the Social Web meets the Semantic Web", Web Semantics: Science, Services and Agents on the World Wide Web, 2007, pp. 1-19.
Gruber, Tom, "Despite our Best Efforts, Ontologies are not the Problem", AAAI Spring Symposium, Available at <http://tomgruber.org/writing/aaai-ss08.htm>, 2008, pp. 1-40.
Gruber, Tom, "Enterprise Collaboration Management with Intraspect", Intraspect Technical White Paper, Jul. 2001, pp. 1-24.
Gruber, Tom, "Every Ontology is a Treaty—A Social Agreement—Among People with Some Common Motive in Sharing", Official Quarterly Bulletin of AIS Special Interest Group on Semantic Web and Information Systems, vol. 1, No. 3, 2004, pp. 1-5.
Gruber, Tom, "Helping Organizations Collaborate, Communicate, and Learn", Presentation to NASA Ames Research, intraspect, available at <http://tomgruber.org/writing/organizational-intelligence-talk.htm>, Mar.-Oct. 2003, 30 pages.
Gruber, Tom, "Intelligence at the Interface: Semantic Technology and the Consumer Internet Experience", Presentation at Semantic Technologies Conference, Available at <http://tomgruber.org/writing/semtech08.htm>, 2008, pp. 1-40.
Gruber, Tom, "It Is What It Does: The Pragmatics of Ontology for Knowledge Sharing", Proceedings of the International CIDOC CRM Symposium, Available at <http://tomgruber.org/writing/cidoc-ontology.htm>, Mar. 26, 2003, 21 pages.
Gruber, Tom, "Ontologies, Web 2.0 and Beyond", Ontology Summit, available at <http://tomgruber.org/writing/ontolog-social-web-keynote.htm>, Apr. 24, 2007, 17 pages.
Gruber, Tom, "Ontology of Folksonomy: A Mash-up of Apples and Oranges", Int'l Journal on Semantic Web & Information Systems, vol. 3, No. 2, 2007, 7 pages.
Gruber, Tom, "Siri, a Virtual Personal Assistant—Bringing Intelligence to the Interface", Semantic Technologies conference, Jun. 16, 2009, 21 pages.
Gruber, Tom, "TagOntology", Presentation to Tag Camp, Oct. 29, 2005, 20 pages.
Gruber, Tom, "Where the Social Web meets the Semantic Web", Presentation at the 5th International Semantic Web Conference, Nov. 7, 2006, 38 pages.
Guida et al., "NLI: A Robust Interface for Natural Language Person-Machine Communication", Int. J. Man-Machine Studies, vol. 17, 1982, pp. 417-433.
Guzzoni et al., "A Unified Platform for Building Intelligent Web Interaction Assistants", Proceedings of the 2006 IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology, Computer Society, 2006, 4 pages.
Guzzoni et al., "Active, A Platform for Building Intelligent Operating Rooms", Surgetica 2007 Computer-Aided Medical Interventions: tools and Applications, Paris, 2007, Sauramps Medical, http://lsro.epfl.ch/page-68384-en.html,, 2007, 8 pages.
Guzzoni et al., "Active, A Platform for Building Intelligent Software,", Computational Intelligence, available online at <http://www.informatik.uni-trier.del-ley/pers/hd/g/Guzzoni:Didier >, 2006, 5 pages.
Guzzoni et al., "Active, A Tool for Building Intelligent User Interfaces", ASC 2007, Palma de Mallorca, <http://lsro.epfl.ch/page-34241.html>, 2007, 6 pages.
Guzzoni et al., "Many Robots Make Short Work", AAAI Robot Contest, SRI International, 1996, pp. 1-9.
Guzzoni et al., "Modeling Human-Agent Interaction with Active Ontologies", AAAI Spring Symposium, Interaction Challenges for Intelligent Assistants, Stanford University, Palo Alto, California, 2007, 8 pages.
Guzzoni, D., "Active: A unified platform for building intelligent assistant applications", Oct. 25, 2007, 262 pages.
Haas et al., "An Approach to Acquiring and Applying Knowledge", SRI international Technical Note 227, Nov. 1980, 22 pages.
Hadidi et al., "Students' Acceptance of Web-Based Course Offerings: An Empirical Assessment", Proceedings of the Americas Conference on Information Systems (AMCIS), 1998, 4 pages.
Hardwar, Devemder, "Driving App Waze Builds its own Siri for Hands-Free Voice Control", retrieved from internet on Feb. 9, 2012 <http ://ventu rebeat. com/20 12/0 2/09/ driving-a pp-waze-bu i lds-its-own-siri-for -hands-freevoice-control/>, 4 pages.
Harris, F. J., "On the Use of Windows for Harmonic Analysis with the Discrete Fourier Transform", In Proceedings of the IEEE, vol. 66, No. 1, Jan. 1978, 34 pages.
Hawkins et al., "Hierarchical Temporal Memory: Concepts, Theory, and Terminology", Numenta, Inc., Mar. 27, 2007, pp. 1-20.
He et al., "Personal Security Agent: KQML-Based PKI", The Robotics Institute, Carnegie-Mellon University, paper, 1997, pp. 1-14.
Helm et al., "Building Visual Language Parsers", In Proceedings of CHI'91 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 1991, pp. 105-112.
Hendrix et al., "Developing a Natural Language Interface to Complex Data", ACM Transactions on Database Systems, vol. 3, No. 2, Jun. 1978, pp. 105-147.
Hendrix et al., "Transportable Natural-Language Interfaces to Databases", SRI International, Technical Note 228, Apr. 30, 1981, 18 pages.
Hendrix et al., "Human Engineering for Applied Natural Language Processing", SRI International, Technical Note 139, Feb. 1977, 27 pages.
Hendrix, Gary G., "Klaus: A System for Managing Information and Computational Resources", SRI International, Technical Note 230, Oct. 1980, 34 pages.
Hendrix, Gary G., "Lifer: A Natural Language Interface Facility", SRI Stanford Research Institute, Technical Note 135, Dec. 1976, 9 pages.
Hendrix, Gary G., "Natural-Language Interface", American Journal of Computational Linguistics, vol. 8, No. 2, Apr.-Jun. 1982, pp. 56-61.
Hendrix, Gary G., "The Lifer Manual: A Guide to Building Practical Natural Language Interfaces", SRI International, Technical Note 138, Feb. 1977, 76 pages.
Hermansky, H., "Perceptual Linear Predictive (PLP) Analysis of Speech", Journal of the Acoustical Society of America, vol. 87, No. 4, Apr. 1990, pp. 1738-1752.
Hermansky, H., "Recognition of Speech in Additive and Convolutional Noise Based on Rasta Spectral Processing", In proceedings of IEEE International Conference on Acoustics, speech and Signal Processing (ICASSP'93), Apr. 27-30, 1993, pp. II-83-II-86.
Hirschman et al., "Multi-Site Data Collection and Evaluation in Spoken Language Understanding", Proceedings of the workshop on Human Language Technology, 1993, pp. 19-24.
Hobbs et al., "Fastus: A System for Extracting Information from Natural-Language Text", SRI International, Technical Note 519, Nov. 19, 1992, 26 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Hobbs et al., "Fastus: Extracting Information from Natural-Language Texts", SRI International, 1992, pp. 1-22.
Hobbs, Jerry R., "Sublanguage and Knowledge", SRI International, Technical Note 329, Jun. 1984, 30 pages.
Hodjat et al., "Iterative Statistical Language Model Generation for Use with an Agent-Oriented Natural Language Interface", Proceedings of HCI International, vol. 4, Jun. 22-27, 2003, pp. 1422-1426.
Hoehfeld et al., "Learning with Limited Numerical Precision Using the Cascade-Correlation Algorithm", IEEE Transactions on Neural Networks, vol. 3, No. 4, Jul. 1992, 18 pages.
Holmes, J. N., "Speech Synthesis and Recognition—Stochastic Models for Word Recognition", Published by Chapman & Hall, London, ISBN 0 412 534304, 1998, 7 pages.
Hon et al., "CMU Robust Vocabulary-Independent Speech Recognition System", IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP-91), Apr. 14-17, 1991, pp. 889-892.
Huang et al., "The SPHINX-II Speech Recognition System: An Overview", Computer, Speech and Language, Jan. 15, 1992, pp. 1-12.
Issar et al., "CMU's Robust Spoken Language Understanding System", Proceedings of Eurospeech, 1993, 4 pages.
Issar, Sunil, "Estimation of Language Models for New Spoken Language Applications", Proceedings of 4th International Conference on Spoken language Processing, Oct. 3-6, 1996, 4 pages.
Jacobs et al., "Scisor: Extracting Information from On-Line News", Communications of the ACM, vol. 33, No. 11, Nov. 1990, pp. 88-97.
Janas, Jurgen M., "The Semantics-Based Natural Language Interface to Relational Databases", Chapter 6, Cooperative Interfaces to Information Systems, 1986, pp. 143-188.
Jelinek, F., "Self-Organized Language Modeling for Speech Recognition,", Readings in Speech Recognition, edited by Alex Waibel and Kai-Fu Lee, Morgan Kaufmann Publishers, Inc., ISBN: 1-55860-124-4, May 15, 1990, 63 pages.
Jennings et al., "A Personal News Service Based on a User Model Neural Network", IEICE Transactions on Information and Systems, vol. E75-D, No. 2, Tokyo, JP, Mar. 1992, pp. 198-209.
Ji et al., "A Method for Chinese Syllables Recognition based upon Sub-syllable Hidden Markov Model", 1994 International Symposium on Speech, Image Processing and Neural Networks, Hong Kong, Apr. 13-16, 1994, pp. 730-733.
Johnson, Julia A., "A Data Management Strategy for Transportable Natural Language Interfaces", Doctoral thesis submitted to the Department of Computer Science, University of British Columbia, Canada, Jun. 1989, 285 pages.
Jones, J., "Speech Recognition for Cyclone", Apple Computer, Inc., E.R.S.Revision 2.9, Sep. 10, 1992, 93 pages.
Julia et al., "http://www.speech.sri.com/demos/atis.html", Proceedings of AAAI, Spring Symposium, 1997, 5 pages.
Julia et al., "Un editeur interactif de tableaux dessines a main levee (An Interactive Editor for Hand-Sketched Tables)", Traitement du Signal, vol. 12, No. 6, 1995, pp. 619-626.
Kahn et al., "CoABS Grid Scalability Experiments", Autonomous Agents and Multi-Agent Systems, vol. 7, 2003, pp. 171-178.
Kamel et al., "A Graph Based Knowledge Retrieval System", IEEE International Conference on Systems, Man and Cybernetics, 1990, pp. 269-275.
Karp, P. D., "A Generic Knowledge-Base Access Protocol", <http://lecture.cs.buu.ac.th/-f50353/Document/gfp.pdf>, May 12, 1994, 66 pages.
Kats et al., "Exploiting Lexical Regularities in Designing Natural Language Systems", In the Proceedings of the 12th International Conference on Computational Linguistics, 1988, pp. 1-22.
Katz et al., "REXTOR: A System for Generating Relations from Natural Language", In Proceedings of the ACL Workshop on Natural Language Processing and Information Retrieval (NLP&IR), Oct. 2000, 11 pages.
Katz, Boris, "A Three-Step Procedure for Language Generation", Massachusetts Institute of Technology, A.I. Memo No. 599, Dec. 1980, pp. 1-40.
Katz, Boris, "Annotating the World Wide Web Using Natural Language", In Proceedings of the 5th RIAO Conference on Computer Assisted Information Searching on the Internet, 1997, 7 pages.
Katz, Boris, "Using English for Indexing and Retrieving", Proceedings of the 1st RIAO Conference on User-Oriented Content-Based Text and Image Handling, 1988, pp. 314-332.
Katz, Slava. M., "Estimation of Probabilities from Sparse Data for the Language Model Component of a Speech Recognizer", IEEE Transactions on Acoustics, Speech, and Signal Processing, vol. ASSP-35, No. 3, Mar. 1987, 3 pages.
Kickstarter, "Ivee Sleek: Wi-Fi Voice-Activated Assistant", available online at <https://www.kickstarter.com/projects/ivee/ivee-sleek-wi-fi-voice-activated-assistant> retrived from intemet on Feb. 10, 2014, 13 pages.
Kitano, H., "ΦDM-Dialog: An Experimental Speech-to-Speech Dialog Translation System", Computer, vol. 24, No. 6, Jun. 1991, 13 pages.
Klabbers et al., "Reducing Audible Spectral Discontinuities", IEEE Transactions on Speech and Audio Processing, vol. 9, No. 1, Jan. 2001, pp. 39-51.
Klatt Dennis H., "Linguistic Uses of Segmental Duration in English: Acoustic and Perpetual Evidence", Journal of the Acoustical Society of America, vol. 59, No. 5, May 1976, pp. 1208-1221.
KnowNav, "Knowledge Navigator", YouTube Video available at <http://www.youtube.com/watch?v=QRH8eimU_20>, Apr. 29, 2008, 1 page.
Kominek et al., "Impact of Durational Outlier Removal from Unit Selection Catalogs", 5th ISCA Speech Synthesis Workshop, Jun. 14-16, 2004, 6 pages.
Konolige, Kurt, "A Framework for a Portable Natural-Language Interface to Large Data Bases", SRI International, Technical Note 197, Oct. 12, 1979, 54 pages.
Kubala et al., "Speaker Adaptation from a Speaker-Independent Training Corpus", International Conference on Acoustics, Speech, and Signal Processing (ICASSP'90), Apr. 3-6, 1990, 4 pages.
Kubala et al., "The Hub and Spoke Paradigm for CSR Evaluation", Proceedings of the Spoken Language Technology Workshop, Mar. 6-8, 1994, 9 pages.
Laird et al., "SOAR: An Architecture for General Intelligence", Artificial Intelligence, vol. 33, 1987, pp. 1-64.
Langly et al., "A Design for the ICARUS Architechture", SIGART Bulletin, vol. 2, No. 4, 1991, pp. 104-109.
Larks, "Intelligent Software Agents", Available Online at <http://www.cs.cmu.edu/~softagents/larks.html> retrieved on Mar. 15, 2013, 2006, 2 pages.
Lee et al., "A Real-Time Mandarin Dictation Machine for Chinese Language with Unlimited Texts and Very Large Vocabulary", International Conference on Acoustics, Speech and Signal Processing, vol. 1, Apr. 3-6, 1990, 5 pages.
Lee et al., "Golden Mandarin(II)—An Improved Single-Chip Real-Time Mandarin Dictation Machine for Chinese Language with Very Large Vocabulary", 0-7803-0946-4/93 © 19931EEE, 1993, 4 pages.
Lee et al., "Golden Mandarin(II)—An Intelligent Mandarin Dictation Machine for Chinese Character Input with Adaptation/Learning Functions", International Symposium on Speech, Image Processing and Neural Networks, Hong Kong, Apr. 13-16, 1994, 5 pages.
Lee et al., "System Description of Golden Mandarin (I) Voice Input for Unlimited Chinese Characters", International Conference on Computer Processing of Chinese & Oriental Languages, vol. 5, Nos. 3 & 4, Nov. 1991, 16 pages.
Lee, K. F., "Large-Vocabulary Speaker-Independent Continuous Speech Recognition: The SPHINX System", Partial Fulfillment of the requirements for the degree of Doctor of Philosophy, Computer Science Department, Carnegie Mellon University, Apr. 18, 1988, 195 pages.
Lemon et al., "Multithreaded Context for Robust Conversational Interfaces: Context-Sensitive Speech Recognition and Interpretation of Corrective Fragments", ACM Transactions on Computer-Human Interaction, vol. 11, No. 3, Sep. 2004, pp. 241-267.

(56) **References Cited**

OTHER PUBLICATIONS

Leong et al., "CASIS: A Context-Aware Speech Interface System", Proceedings of the 10th International Conference on Intelligent user Interfaces, San Diego, California, Jan. 9-12, 2005, pp. 231-238.
Cheyer, Adam, "About Adam Cheyer", available online at <http://www.adam.cheyer.com/about.html>, retrieved from Internet on Sep. 17, 2012, 2 pages.
Codd, E. F., "Databases: Improving Usability and Responsiveness—How About Recently", 1978, pp. 3-28.
Cohen et al., "An Open Agent Architecture", SRI International, 1994, pp. 1-8.
Coles et al., "Chemistry Question-Answering", Technical Note 9, Jun. 1969, 15 pages.
Coles et al., "Techniques for Information Retrieval Using an Inferential Question-Answering System with Natural-Language Input", Technical Note74, Nov. 1972, 198 Pages.
Coles Stephen L., "The Application of Theorem Proving to Information Retrieval", Technical Note 51, Jan. 1971, 21 pages.
Conklin, "Hypertext: An Introduction and Survey", Computer Magazine, Sep. 1987, 25 pages.
Connolly et al., "Fast Algorithms for Complex Matrix Multiplication Using Surrogates", IEEE Transactions on Acoustics, Speech, and Signal Processing, vol. 37, No. 6, Jun. 1989, 13 pages.
Constantinides et al., "A Schema Based Approach to Dialog Control", Proceedings of the International Conference on Spoken Language Processing, 1998, 4 pages.
Cox et al., "Speech and Language Processing for Next-Millennium Communications Services", Proceedings of the IEEE, vol. 88, No. 8, Aug. 2000, pp. 1314-1337.
Craig et al., "Deacon: Direct English Access and Control", AFIPS Conference Proceedings, vol. 29, Nov. 7-10, 1966, pp. 365-380.
Cutkosky et al., "PACT: An Experiment in Integrating Concurrent Engineering Systems", Jan. 1993, pp. 1-13.
Dar et al., "DTL's DataSpot: Database Exploration Using Plain Language", Proceedings of the 24th VLDB Conference, 1998, pp. 645-649.
Davis et al., "A Personal Handheld Multi-Modal Shopping Assistant", IEEE, 2006, 9 pages.
Decker et al., "Designing Behaviors for Information Agents", Jul. 6, 1996, pp. 1-15.
Decker et al., "Matchmaking and Brokering", May 16, 1996, pp. 1-19.
Deerwester et al., "Indexing by Latent Semantic Analysis", Journal of the American Society for Information Science, vol. 41, No. 6, Sep. 1990, 19 pages.
Deller, Jr., et al., "Discrete-Time Processing of Speech Signals", May 13, 1993, pp. 114-137.
Digital Equipment Corporation, "Open VMS Software Overview", Dec. 1995, 159 pages.
Domingue et al., "Web Service Modeling Ontology (WSMO)—An Ontology for Semantic Web Services", Position paper at the W3C Workshop on Frameworks for Semantics in Web Services, Jun. 9-10, 2005, 6 pages.
Donovan, Robert E., "A New Distance Measure for Costing Spectral Discontinuities in Concatenative Speech Synthesisers", 2001, 4 pages.
Dowding et al., "Gemini: A Natural Language System for Spoken-Language Understanding", Proceedings of the Thirty-First Annual Meeting of the Association for Computational Linguistics, 1993, 8 pages.
Dowding et al., "Interleaving Syntax and Semantics in an Efficient Bottom-Up Parser", Proceedings of the 32nd Annual Meeting of the Association for Computational Linguistics, 1994, 7 pages.
Elio et al., "On Abstract Task Models and Conversation Policies", 1999, pp. 1-10.
Epstein et al., "Natural Language Access to a Melanoma Data Base", Technical Note 171, Sep. 1978, 7 pages.
Ericsson et al., "Software Illustrating a Unified Approach to Multimodality and Multilinguality in the in-home Domain", Talk and Look: Tools for Ambient Linguistic Knowledge, Dec. 22, 2006, 127 pages.
Evi, "Meet Evi: The One Mobile App that Provides Solutions for Your Everyday Problems", avialable online at <http://www.evi.com/>, retrieved on Feb. 8, 2012, 3 pages.
Grosz et al., "Dialogic: A Core Natural-Language Processing System", SRI International, Nov. 9, 1982, 17 pages.
Exhibit, 1, "Natural Language Interface Using Constrained Intermediate Dictionary of Results", List of Publications Manually reviewed for the Search of U.S. Pat. No. 7,177,798, Mar. 22, 2013, 1 page.
Feigenbaum et al., "Computer-assisted Semantic Annotation of Scientific Life Works", Oct. 15, 2007, 22 pages.
Ferguson et al., "TRIPS: An Integrated Intelligent Problem-Solving Assistant,", Proceedings of the Fifteenth National Conference on Artificial Intelligence (AAAI-98) and Tenth Conference on Innovative Applications of Artificial Intelligence (IAAI-98), 1998, 7 pages.
Fikes et al., "A Network-based knowledge Representation and its Natural Deduction System", SRI International, Jul. 1977, 43 pages.
Frisse, M. E., "Searching for Information in a Hypertext Medical Handbook", Communications of the ACM, vol. 31, No. 7, Jul. 1988, 8 pages.
Gamback et al., "The Swedish Core Language Engine", NOTEX Conference, 1992, 17 pages.
Gannes, Liz, "Alfred App Gives Personalized Restaurant Recommendations", AllThingsD, Jul. 18, 2011, pp. 1-3.
Gautier et al., "Generating Explanations of Device Behavior Using Compositional Modeling and Causal Ordering", CiteSeerx, 1993, pp. 89-97.
Gervasio et al., "Active Preference Learning for Personalized Calendar Scheduling Assistancae", CiteSeerx, In Proc. of IUI'05, Jan. 9-12, 2005, pp. 90-97.
Glass et al., "Multilingual Language Generation Across Multiple Domains", International Conference on Spoken Language Processing, Japan, Sep. 18-22, 1994, 5 pages.
Glass et al., "Multilingual Spoken-Language Understanding in the Mit Voyager System", <http://groups.csail.mit.edu/sls/publications/1995/speechcomm95-voyager.pdf>, Aug. 1995, 29 pages.
Glass, Alyssa, "Explaining Preference Learning", CiteSeerx, 2006, pp. 1-5.
Goddeau et al., "A Form-Based Dialogue Manager for Spoken Language Applications", http://phasedance.com/pdf!icslp96.pdf, Oct. 1996, 4 pages.
Goddeau et al., "Galaxy: A Human-Language Interface to On-Line Travel Information", International Conference on Spoken Language Processing 1994, Yokohama, 1994, pp. 707-710.
Goldberg et al., "Using Collaborative Filtering to Weave an Information Tapestry", Communications of the ACM, vol. 35, No. 12, Dec. 1992, 10 pages.
Gorin et al., "On Adaptive Acquisition of Language", International Conference on Acoustics, Speech, and Signal Processing (ICASSP'90), vol. 1, Apr. 3-6, 1990, 5 pages.
Gotoh et al., "Document Space Models Using Latent Semantic Analysis", In Proceedings of Eurospeech, 1997, 4 pages.
Gray, R. M., "Vector Quantization", IEEE ASSP Magazine, Apr. 1984, 26 pages.
Green, C., "The Application of Theorem Proving to Question-Answering Systems", SRI Stanford Research Institute, Artificial Intelligence Group, Jun. 1969, 169 pages.
Gregg et al., "DSS Access on the WWW: An Intelligent Agent Prototype", Proceedings of the Americas Conference on Information Systems—Association for Information Systems, 1998, 3 pages.
Grishman et al., "Computational Linguistics: An Introduction", © Cambridge University Press, 1986, 172 pages.
Savoy, J., "Searching Information in Hypertext Systems Using Multiple Sources of Evidence", International Journal of Man-Machine Studies, vol. 38, No. 6, Jun. 1996, pp. 1017-1030.
Scagliola, C., "Language Models and Search Algorithms for Real-Time Speech Recognition", International Journal of Man-Machine Studies, vol. 22, No. 5, 1985, pp. 523-547.

(56) **References Cited**

OTHER PUBLICATIONS

Schmandt et al., "Augmenting a Window System with Speech Input", IEEE Computer Society, Computer, vol. 23, No. 8, Aug. 1990, pp. 50-56.
Ward et al., "A Class Based Language Model for Speech Recognition", Conference Proceedings International Conference on Acoustics, Speech, and Signal Processing, 1996, ICASSP-96 , pp. 416-418.
Schütze, H., "Dimensions of Meaning", Proceedings of Supercomputing'92 Conference, Nov. 16-20, 1992, 10 pages.
Seneff et al., "A New Restaurant Guide Conversational System: Issues in Rapid Prototyping for Specialized Domains", Proceedings of Fourth International Conference on Spoken Language, 1996. ICSLP 96, 1996, pp. 665-668.
Sharoff et al., "Register-domain Separation as a Methodology for Development of Natural Language Interfaces to Databases", Proceedings of Human-Computer Interaction (INTERACT'99), 1999, 7 pages.
Sheth et al., "Evolving Agents for Personalized Information Filtering", In Proceedings of the Ninth Conference on Artificial Intelligence for Applications, Mar. 1-5, 1993, 9 pages.
Sheth et al., "Relationships at the Heart of Semantic Web: Modeling, Discovering, and Exploiting Complex Semantic Relationships", Enhancing the Power of the Internet: Studies in Fuzziness and Soft Computing, Oct. 13, 2002, pp. 1-38.
Shikano et al., "Speaker Adaptation Through Vector Quantization", IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP'86), vol. 11, Apr. 1986, 4 pages.
Shimazu et al., "CAPIT: Natural Language Interface Design Tool with Keyword Analyzer and Case-Based Parser,", NEG Research & Development, vol. 33, No. 4, Oct. 1992, 11 pages.
Shinkle, L., "Team User's Guide", SRI International, Artificial Intelligence Center, Nov. 1984, 78 pages.
Shklar et al., "Info Harness: Use of Automatically Generated Metadata for Search and Retrieval of Heterogeneous Information", 1995 Proceedings of CAiSE'95, Finland, 1995.
Sigurdsson et al., "Mel Frequency Cepstral Coefficients: An Evaluation of Robustness of MP3 Encoded Music", In Proceedings of the 7th International Conference on Music Information Retrieval ISMIR, 2006, 4 pages.
Silverman et al., "Using a Sigmoid Transformation for Improved Modeling of Phoneme Duration", Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing, Mar. 15-19, 1999, 5 pages.
Simonite, Tom, "One Easy Way to Make Siri Smarter", Technology Review, Oct. 18, 2011, 2 pages.
Singh, N., "Unifying Heterogeneous Information Models", Communications of the ACM, 1998, 13 pages.
SRI International, "The Open Agent Architecture.TM. 1.0 Distribution", Open Agent Architecture (OAA), 1999, 2 pages.
SRI2009, "SRI Speech: Products: Software Development Kits: EduSpeak", available a <http://web.archive.org/web/20090828084033/http://www.speechatsri.com/products/eduspeak>shtml., 2009, 2 pages.
Starr et al., "Knowledge-Intensive Query Processing", Proceedings of the 5th KRDB Workshop, Seattle, May 31, 1998, 6 pages.
Stent et al., "The CommandTalk Spoken Dialogue System", SRI International, 1999, pp. 183-190.
Stern et al., "Multiple Approaches to Robust Speech Recognition", Proceedings of Speech and Natural Language Workshop, 1992, 6 pages.
Stickel, "A Nonclausal Connection-Graph Resolution Theorem-Proving Program", Proceedings of AAAI'82, 1982, pp. 1-13.
Sugumaran, V., "A Distributed Intelligent Agent-Based Spatial Decision Support System", Proceedings of the Americas Conference on Information systems (AMCIS), Dec. 31, 1998, 4 pages.
Sycara et al., "Coordination of Multiple Intelligent Software Agents", International Journal of Cooperative Information Systems (IJCIS), vol. 5, No. 2 & 3, Jun. & Sep. 1996, 33 pages.
Sycara et al., "Distributed Intelligent Agents", IEEE Expert, vol. 11, No. 6, Dec. 1996, 32 pages.
Sycara et al., "Dynamic Service Matchmaking Among Agents in Open Information Environments", SIGMOD Record, 1999, 7 pages.
Sycara et al., "The RETSINA MAS Infrastructure", Autonomous Agents and Multi-Agent Systems, vol. 7, 2003, 20 pages.
Tenenbaum et al., "Data Structure Using Pascal", 1981 Prentice-Hall, Inc, 1981, 34 pages.
TextnDrive, "Text'nDrive App Demo—Listen and Reply to your Messages by Voice while Driving!", YouTube Video available at <http://www.youtube.com/watch?v=WaGfzoHsAMw>, Apr. 27, 2010, 1 page.
Tofel et al., "SpeakTolt: A Personal Assistant for Older iPhones, iPads", Apple News, Tips and Reviews, Feb. 9, 2012, 7 pages.
Tsai et al., "Attributed Grammar—A Tool for Combining Syntactic and Statistical Approaches to Pattern Recognition", IEEE Transactions on Systems, Man, and Cybernetics, vol. SMC-10, No. 12, Dec. 1980, 13 pages.
Tucker, Joshua, "Too Lazy to Grab Your TV Remote? Use Siri Instead", Engadget, Nov. 30, 2011, 8 pages.
Tur et al., "The CALO Meeting Assistant System", IEEE Transactions on Audio, Speech, and Language Processing, vol. 18, No. 6, Aug. 2010, pp. 1601-1611.
Tur et al., "The CALO Meeting Speech Recognition and Understanding System", Proc. IEEE Spoken Language Technology Workshop, 2008, 4 pages.
Tyson et al., "Domain-Independent Task Specification in the TACITUS Natural Language System", SRI International, Artificial Intelligence Center, May 1990, 16 pages.
Udell, J., "Computer Telephony", BYTE, vol. 19, No. 7, Jul. 1, 1994, 9 pages.
Van Santen, J. P., "Contextual Effects on Vowel Duration", Journal Speech Communication, vol. 11, No. 6, Dec. 1992, 34 pages.
Vepa et al., "New Objective Distance Measures for Spectral Discontinuities in Concatenative Speech Synthesis", In Proceedings of the IEEE 2002 Workshop on Speech Synthesis, 2002, 4 pages.
Verschelde, J., "MATLAB Lecture 8. Special Matrices in MATLAB,", UIC Dept. of Math., Stat. & C.S., MCS 320, Introduction to Symbolic Computation, Nov. 23, 2005, 4 pages.
Vingron, M., "Near-Optimal Sequence Alignment", Deutsches Krebsforschungszentrum (DKFZ), Abteilung Theoretische Bioinformatik, Heidelberg, Germany, Jun. 1996, 20 pages.
Vlingo, "Vlingo Launches Voice Enablement Application on Apple App Store", Press Release, Dec. 3, 2008, 2 pages.
Vlingo LnCar, "Distracted Driving Solution with Vlingo InCar", YouTube by Vlingo Voice on (Oct. 6, 2010) 2:38 minute video uploaded to Retrieved from Internet on Jun. 6, 2012<http://www.youtube.com/watch?v=Vqs8XfXxgz4?, 2 pages.
VoiceAssist, "Send Text, Listen to and Send E~Mail By Voice", YouTube Video available at <http://www.youtube.com/watch?v=0tEU61nHHA4>, Jul. 30, 2009, 1 page.
VoiceOnTheGo, "Voice On The Go (BlackBerry)", YouTube available at <http://www.youtube.com/watch?v=pJqpWgQS98w>, Jul. 27, 2009, 1 page.
Wahlster et al., "Smartkom: Multimodal Communication with a Life-Like Character,", EUROSPEECH—Scandinavia, 7th European Conference on Speech Communication and Technology, 2001, 5 pages.
Waldinger et al., "Deductive Question Answering from Multiple Resources", New Directions in Question Answering, published by AAAI, Menlo Park, 2003, 22 pages.
Walker et al., "Natural Language Access to Medical Text", SRI International, Artificial Intelligence Center, Mar. 1981, 23 pages.
Waltz, D., "An English Language Question Answering System for a Large Relational Database", © 1978 ACM, vol. 21, No. 7, 1978, 14 pages.
"Integrated Audio-Graphics User Interface", IBM Technical Disclosure Bulletin, vol. 33, No. 11, Apr. 1991, pp. 368-371.
"Interactive Voice", available online at <http://www.helloivee.com/company/> retrieved from internet on Feb. 10, 2014, 2 pages.
"Meet Ivee Your Wi-Fi Voice Activated Assistant", available online at <http://www.helloivee.com/> retrieved from internet on Feb. 10, 2014, 8 pages.

(56) **References Cited**

OTHER PUBLICATIONS

"Mel Scale", Wikipedia the Free Encyclopedia, last modified on Oct. 13, 2009 and retrieved on Jul. 28, 2010, available online <http://en.wikipedia.org/wiki/Mel_scale>, 2 pages.
"Minimum Phase", Wikipedia the free Encyclopedia, Last Modified on Jan. 12, 2010 and retrieved on Jul. 28, 2010, available online at <http://en.wikipedia.org/wiki/Minimum_phase>, 8 pages.
"Speech Editor", IBM Technical Disclosure Bulletin, vol. 29, No. 10, Mar. 1987, pp. 4512-4514.
"Speech Recognition with Hidden Markov Models of Speech Waveforms", IBM Technical Disclosure Bulletin, vol. 34, No. 1, Jun. 1991, pp. 7-16.
Ex-Parte Quayle Action received for U.S. Appl. No. 12/244,713, mailed on Sep. 10, 2012, 5 pages.
Non Final Office Action received for U.S. Appl. No. 12/244,713, mailed on Dec. 23, 2011, 11 pages.
Bahl et al., "Large Vocabulary Natural Language Continuous Speech Recognition", In Proceedings of 1989 International Conference on Acoustics, Speech, and Signal Processing, vol. 1, May 23-26, 1989, 6 pages.
Notice of Allowance received for U.S. Appl. No. 12/244,713, mailed on Aug. 7, 2012, 7 pages.
Notice of Allowance received for U.S. Appl. No. 12/244,713, mailed on May 10, 2012, 5 pages.
Final Office Action received for U.S. Appl. No. 13/053,144, mailed on Nov. 19, 2013, 24 pages.
Non Final Office Action received for U.S. Appl. No. 13/053,144, mailed on Mar. 22, 2013, 18 pages.
Notice of Allowance received for U.S. Appl. No. 13/480,422, mailed on Jul. 19, 2012, 9 pages.
Supplemental Notice of Allowance received for U.S. Appl. No. 13/480,422, mailed on Sep. 27, 2012, 2 pages.
Notice of Allowance received for U.S. Appl. No. 13/604,556, mailed on Apr. 1, 2013, 9 pages.
Notice of Allowance received for U.S. Appl. No. 13/604,556, mailed on Jul. 31, 2013, 9 pages.
Acero et al., "Environmental Robustness in Automatic Speech Recognition", International Conference on Acoustics, Speech, and Signal Processing (ICASSP'90), Apr. 3-6, 1990, 4 pages.
Acero et al., "Robust Speech Recognition by Normalization of the Acoustic Space", International Conference on Acoustics, Speech, and Signal Processing, 1991, 4 pages.
Agnes et al., "Spoken Language Translator: First-Year Report", SICS Research Report, Jan. 1994, 161 pages.
Ahlborn et al., "Modeling Spectral Speech Transitions Using Temporal Decomposition Techniques", IEEE International Conference of Acoustics, Speech, and Signal Processing (ICASSP'87), vol. 12, Apr. 1987, 4 pages.
Aikawa et al., "Speech Recognition Using Time-Warping Neural Networks", Proceedings of the 1991 IEEE Workshop on Neural Networks for Signal Processing, Sep. 30 to Oct. 1, 1991, 10 pages.
Alfred App, available online at <http://www.alfredapp.com/>, retrieved on Feb. 8, 2012, 5 pages.
Allen, James, "Natural Language Understanding", 2nd Edition, 1995, 671 pages.
Alshawi et al., "CLARE: A Contextual Reasoning and Cooperative Response Framework for the Core Language Engine—Final Report", SRI International, available online at <http://www.cam.sri.com/tr/crc028/paper.ps.Z>, Dec. 1992, pp. 1-272.
Alshawi et al., "Declarative Derivation of Database Queries from Meaning Representations", Proceedings of the BANKAI Workshop, Oct. 1991, pp. 1-12.
Alshawi et al., "Logical Forms in the Core Language Engine", Proceedings of the 27th Annual Meeting of the Association for Computational Linguistics, 1989, pp. 25-32.
Alshawi et al., "Overview of the Core Language Engine", Proceedings of Future Generation Computing Systems, Sep. 1988, pp. 1-13.
Alshawi, Hiyan, "Translation and Monotonic Interpretation/Generation", SRI International, available online at <http://www.cam.sri.com/tr/crc024/paper.ps.Z>, Jul. 1992, pp. 1-18.
Ambite et al., "Design and Implementation of the CALO Query Manager", American Association for Artificial Intelligence, 2006, 8 pages.
Ambite et al., "Integration of Heterogeneous Knowledge Sources in the CALO Query Manager", The 4th International Conference on Ontologies, DataBases, and Applications of Semantics (ODBASE), 2005, 18 pages.
Anastasakos et al., "Duration Modeling in Large Vocabulary Speech Recognition", International Conference on Acoustics, Speech, and Signal Processing (ICASSP'95), May 9-12, 1995, 4 pages.
Anderson et al., "Syntax-Directed Recognition of Hand-Printed Two-Dimensional Mathematics", In Proceedings of Symposium on Interactive Systems for Experimental Applied Mathematics: Proceedings of the Association for Computing Machinery Inc. Symposium, 1967, 12 pages.
Anonymous, "Speaker Recognition", Wikipedia, The Free Enclyclopedia, Nov. 2, 2010, 3 pages.
Ansari et al., "Pitch Modification of Speech using a Low-Sensitivity Inverse Filter Approach", IEEE Signal Processing Letters, vol. 5, No. 3, Mar. 1998, 3 pages.
Anthony et al., "Supervised Adaption for Signature Verification System", IBM Technical Disclosure, Jun. 1, 1978, 3 pages.
Appelt et al., "Fastus: A Finite-state Processor for Information Extraction from Real-world Text", Proceedings of IJCAI, 1993, 8 pages.
Appelt et al., "SRI International Fastus System MUC-6 Test Results and Analysis", SRI International, 1995, 12 pages.
Appelt et al., "SRI: Description of the JV-FASTUS System Used for MUC-5", SRI International, 1993, pp. 1-19.
Apple Computer, "Guide Maker User's Guide", © Apple Computer, Inc., Apr. 27, 1994, 8 pages.
Apple Computer, "Introduction to Apple Guide", © Apple Computer, Inc., Apr. 28, 1994, 20 pages.
Apple Computer, "Knowledge Navigator", available online at <http://www.youtube.com/watch?v=QRH8eimU_20>, Uploaded on Apr. 29, 2008, 7 pages.
Archbold et al., "A Team User's Guide", SRI International, Technical Note 254, Dec. 21, 1981, 70 pages.
Asanovic et al., "Experimental Determination of Precision Requirements for Back-Propagation Training of Artificial Neural Networks", In Proceedings of the 2nd International Conference of Microelectronics for Neural Networks, 1991, www.ICSI.Berkelev.EDU, 1991, 7 pages.
Atal et al., "Efficient Coding of LPC Parameters by Temporal Decomposition", IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP'83), Apr. 1983, 4 pages.
Bahl et al., "A Maximum Likelihood Approach to Continuous Speech Recognition", IEEE Transaction on Pattern Analysis and Machine Intelligence, vol. PAMI-5, No. 2, Mar. 1983, 13 pages.
Bahl et al., "A Tree-Based Statistical Language Model for Natural Language Speech Recognition", IEEE Transactions on Acoustics, Speech and Signal Processing, vol. 37, No., Jul. 1989, 8 pages.
Bahl et al., "Acoustic Markov Models Used in the Tangora Speech Recognition System", In Proceeding of International Conference on Acoustics, Speech, and Signal Processing (ICASSP'88), vol. 1, Apr. 11-14, 1988, 4 pages.
Bulyko et al., "Error-Correction Detection and Response Generation in a Spoken Dialogue System", Speech Communication, vol. 45, 2005, pp. 271-288.
Owei et al., "Natural Language Query Filtration in the Conceptual Query Language", IEEE, 1997, pp. 539-549.
Pannu et al., "A Learning Personal Agent for Text Filtering and Notification", Proceedings of the International Conference of Knowledge Based Systems, 1996, pp. 1-11.
Papadimitriou et al., "Latent Semantic Indexing: A Probabilistic Analysis", available online at <http://citeseerx.ist.psu.edu/messaqes/downloadsexceeded.html>, Nov. 14, 1997, 21 pages.
Parsons, T. W., "Voice and Speech Processing", Pitch and Formant Estimation © 1987, McGraw-Hill, Inc., ISBN: 0-07-0485541-0, 1987, 15 pages.
Parsons T. W., "Voice and Speech Processin", Linguistics and Technical Fundamentals, Articulatory Phonetics and Phonemics, © 1987 McGraw-Hill, Inc., ISBN: 0-07-0485541-0, 5 pages.

(56) **References Cited**

OTHER PUBLICATIONS

International Preliminary Report on Patentability received for PCT Patent Application No. PCT/US1993/012637, issued on Apr. 10, 1995, 7 pages.
International Preliminary Report on Patentability received for PCT Patent Application No. PCT/US1993/012666, issued on Mar. 1, 1995, 5 pages.
International Search Report received for PCT Patent Application No. PCT/US1993/012666, mailed on Nov. 9, 1994, 8 pages.
International Preliminary Report on Patentability received for PCT Patent Application No. PCT/US1994/011011, issued on Feb. 28, 1996, 4 pages.
International Search Report received for PCT Patent Application No. PCT/US1994/011011, mailed on Feb. 8, 1995, 7 pages.
Written Opinion received for PCT Patent Application No. PCT/US1994/011011, mailed on Aug. 21, 1995, 4 pages.
International Preliminary Report on Patentability received for PCT Patent Application No. PCT/US1995/008369, issued on Oct. 9, 1996, 4 pages.
International Search Report received for PCT Patent Application No. PCT/US1995/008369, mailed on Nov. 8, 1995, 6 pages.
International Search Report and Written Opinion received for PCT Patent Application No. PCT/US2011/020861, mailed on Nov. 29, 2011, 12 pages.
International Preliminary Report on Patentability received for PCT Patent Application No. PCT/US2012/029810, mailed on Oct. 3, 2013, 9 pages.
International Search Report and Written Opinion received for PCT Patent Application No. PCT/US2012/029810, mailed on Aug. 17, 2012, 11 pages.
Pereira, Fernando, "Logic for Natural Language Analysis", SRI International, Technical Note 275, Jan. 1983, 194 pages.
Perrault et al., "Natural-Language Interfaces", SRI International, Technical Note 393, Aug. 22, 1986, 48 pages.
Phoenix Solutions, Inc., A, "Declaration of Christopher Schmandt Regarding the MIT Galaxy System", West Interactive Corporation, a Delaware Corporation, Document 40, Jul. 2, 2010, 162 pages.
Picone, J., "Continuous Speech Recognition Using Hidden Markov Models", IEEE ASSP Magazine, vol. 7, No. 3, Jul. 1990, 16 pages.
Pulman et al., "Clare: A Combined Language and Reasoning Engine", Proceedings of JFIT Conference, available online at <URL: http://www.cam.sri.com/tr/crc042/paper.ps.Z>, 1993, 8 pages.
Rabiner et al., "Fundamental of Speech Recognition", © 1993 AT&T, Published by Prentice-Hall, Inc., ISBN: 0-13-285826-6, 1993, 17 pages.
Rabiner et al., "Note on the Properties of a Vector Quantizer for LPC Coefficients", Bell System Technical Journal, vol. 62, No. 8, Oct. 1983, 9 pages.
Ratcliffe, M., "CiearAccess 2.0 allows SQL searches off-line (Structured Query Language)", ClearAcess Corp., MacWeek, vol. 6, No. 41, Nov. 16, 1992, 2 pages.
Ravishankar, "Efficient Algorithms for Speech Recognition", Doctoral Thesis submitted to School of Computer Science, Computer Science Division, Carnegie Mellon University, Pittsburg, May 15, 1996, 146 pages.
Rayner et al., "Adapting the Core Language Engine to French and Spanish", Cornell University Library, available online at <http:l/arxiv.org/abs/cmp-lg/9605015.>, May 10, 1996, 9 pages.
Rayner et al., "Deriving Database Queries from Logical Forms by Abductive Definition Expansion", Proceedings of the Third Conference on Applied Natural Language Processing, ANLC, 1992, 8 pages.
Rayner et al., "Spoken Language Translation With Mid-90's Technology: A Case Study", EUROSPEECH, ISCA, available online at <http:// db l p. u n i-trier. de/d b/conf/interspeech/eurospeech 1993. html#RaynerBCCDGKKLPPS93>, 1993, 4 pages.
Rayner, M., "Abductive Equivalential Translation and its application to Natural Language Database Interfacing", Dissertation paper, SRI International, Sep. 1993, 163 pages.
Rayner, M., "Linguistic Domain Theories: Natural-Language Database Interfacing from First Principles", SRI International, Cambridge, 1993, 11 pages.
Remde et al., "SuperBook: An Automatic Tool for Information Exploration-Hypertext?", In Proceedings of Hypertext '87, Nov. 13-15, 1987, 14 pages.
Reynolds, C. F., "On-Line Reviews: A New Application of the HICOM Conferencing System", IEE Colloquium on Human Factors in Electronic Mail and Conferencing Systems, Feb. 3, 1989, 4 pages.
Rice et al., "Monthly Program: Nov. 14, 1995", The San Francisco Bay Area Chapter of ACM SIGCHI, Available at <http://www.baychi.org/calendar/19951114>, Nov. 14, 1995, 2 pages.
Rice et al., "Using the Web Instead of a Window System", Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI'96, 1996, pp. 1-14.
Rigoll, G., "Speaker Adaptation for Large Vocabulary Speech Recognition Systems Using Speaker Markov Models", International Conference on Acoustics, Speech, and Signal Processing (ICASSP'89), May 23-26, 1989, 4 pages.
Riley, M D., "Tree-Based Modelling of Segmental Durations", Talking Machines Theories, Models, and Designs, 1992 © Elsevier Science Publishers B.V., North-Holland, ISBN: 08-444-89115.3, 1992, 15 pages.
Rivlin et al., "Maestro: Conductor of Multimedia Analysis Technologies", SRI International, 1999, 7 pages.
Rivoira et al., "Syntax and Semantics in a Word-Sequence Recognition System", IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP'79), Apr. 1979, 5 pages.
Roddy et al., "Communication and Collaboration in a Landscape of B2B eMarketplaces", VerticaiNet Solutions, white paper, Jun. 15, 2000, 23 pages.
Rosenfeld, R., "A Maximum Entropy Approach to Adaptive Statistical Language Modelling", Computer Speech and Language, vol. 10, No. 3, Jul. 1996, 25 pages.
Roszkiewicz, A., "Extending your Apple", Back Talk-Lip Service, A+ Magazine, The Independent Guide for Apple Computing, vol. 2, No. 2, Feb. 1984, 5 pages.
Rudnicky et al., "Creating Natural Dialogs in the Carnegie Mellon Communicator System", Proceedings of Eurospeech, vol. 4, 1999, pp. 1531-1534.
Russell et al., "Artificial Intelligence, A Modern Approac", © 1995 Prentice Hall, Inc., 1995, 121 pages.
Sacerdoti et al., "A Ladder User's Guide (Revised)", SRI International Artificial Intelligence Center, Mar. 1980, 39 pages.
Sagalowicz, D., "AD-Ladder User's Guide", SRI International, Sep. 1980, 42 pages.
Sakoe et al., "Dynamic Programming Algorithm Optimization for Spoken Word Recognition", IEEE Transactions on Acoustics, Speech, and Signal Processing, vol. ASSP-26 No. 1, Feb. 1978, 8 pages.
Salton et al., "On the Application of Syntactic Methodologies in Automatic Text Analysis", Information Processing and Management, vol. 26, No. 1, Great Britain, 1990, 22 pages.
Sameshima et al., "Authorization with security attributes and privilege delegation Access control beyond the ACL", Computer Communications, vol. 20, 1997, 9 pages.
San-Segundo et al., "Confidence Measures for Dialogue Management in the CU Communicator System", Proceedings of Acoustics, Speech, and Signal Processing (ICASSP'00), Jun. 5-9, 2000, 4 pages.
Sato, H., "A Data Model, Knowledge Base, and Natural Language Processing for Sharing a Large Statistical Database,", Statistical and Scientific Database Management, Lecture Notes in Computer Science, vol. 339, 1989, 20 pages.
International Search Report and Written Opinion received for PCT Patent Application No. PCT/US2014/026871, mailed on Jul. 23, 2014, 9 pages.
International Preliminary Report on Patentability received for PCT Patent Application No. PCT/US2014/026871, mailed on Sep. 24, 2015, 7 pages.

* cited by examiner

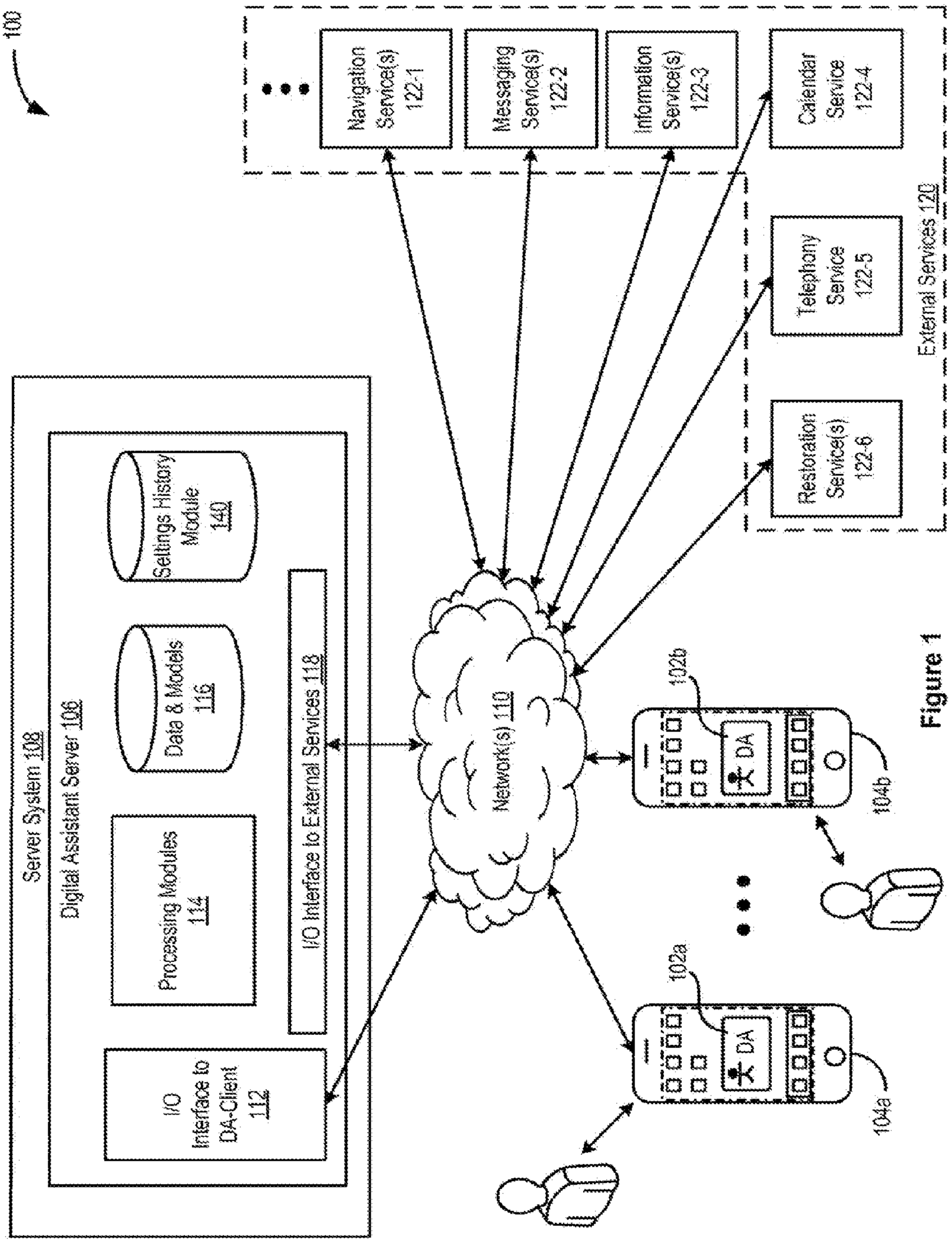

100
Server System 108
Digital Assistant Server 106
Processing Modules 114
Data & Models 116
Settings History Module 140
I/O Interface to External Services 118
I/O Interface to DA-Client 112
Network(s) 110
External Services 120
Navigation Service(s) 122-1
Messaging Service(s) 122-2
Information Service(s) 122-3
Calendar Service 122-4
Telephony Service 122-5
Restoration Service(s) 122-6
102a
102b
DA
104a
104b

Figure 1

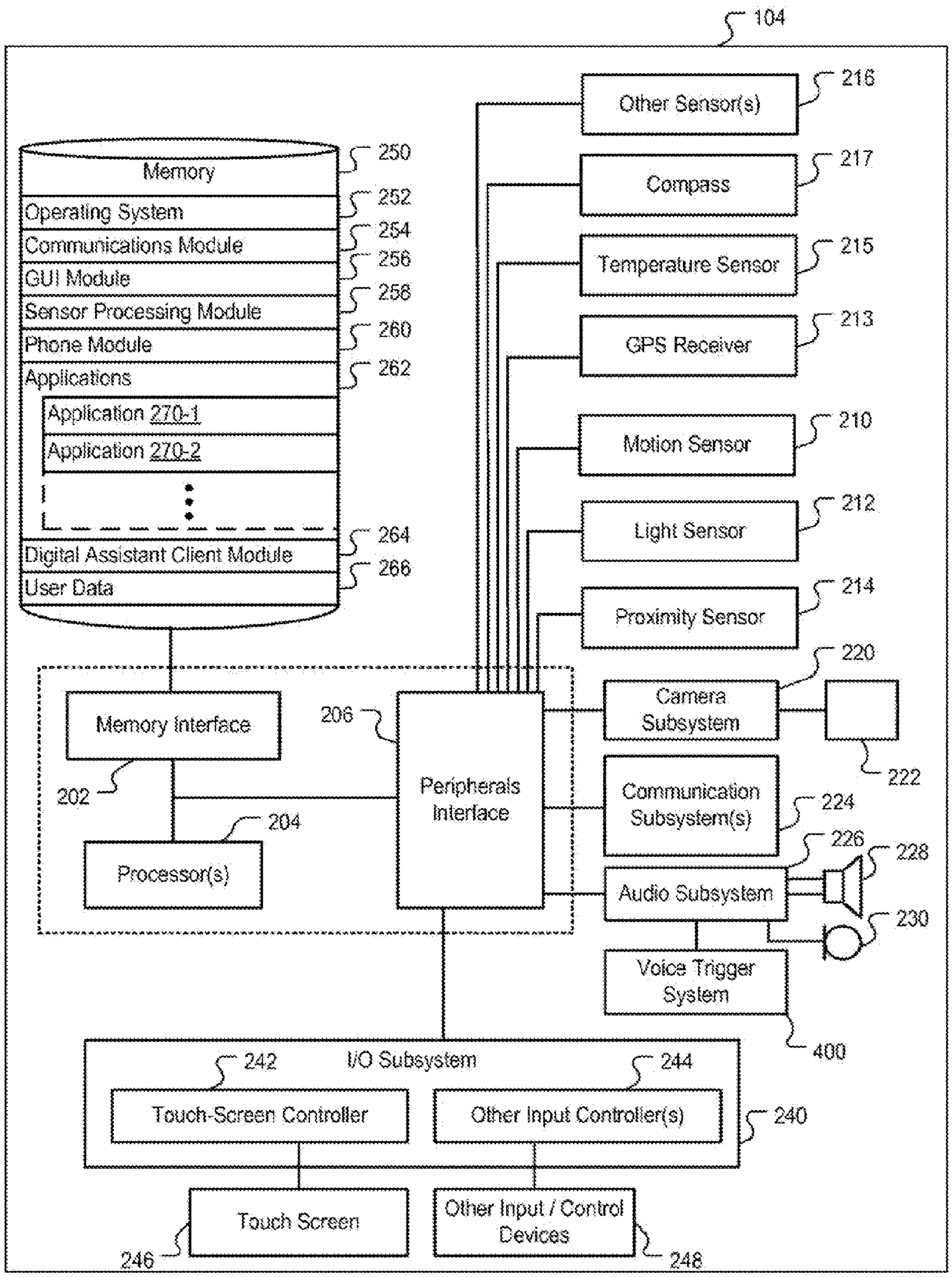

104
Other Sensor(s)
216
Compass
217
Temperature Sensor
215
GPS Receiver
213
Motion Sensor
210
Light Sensor
212
Proximity Sensor
214
Memory
250
Operating System
252
Communications Module
254
GUI Module
256
Sensor Processing Module
258
Phone Module
260
Applications
262
Application 270-1
Application 270-2
264
Digital Assistant Client Module
266
User Data
Memory Interface
202
Processor(s)
204
206
Peripherals Interface
Camera Subsystem
220
222
Communication Subsystem(s)
224
Audio Subsystem
226
228
230
Voice Trigger System
400
I/O Subsystem
242
244
Touch-Screen Controller
Other Input Controller(s)
240
Touch Screen
246
Other Input / Control Devices
248

Figure 2

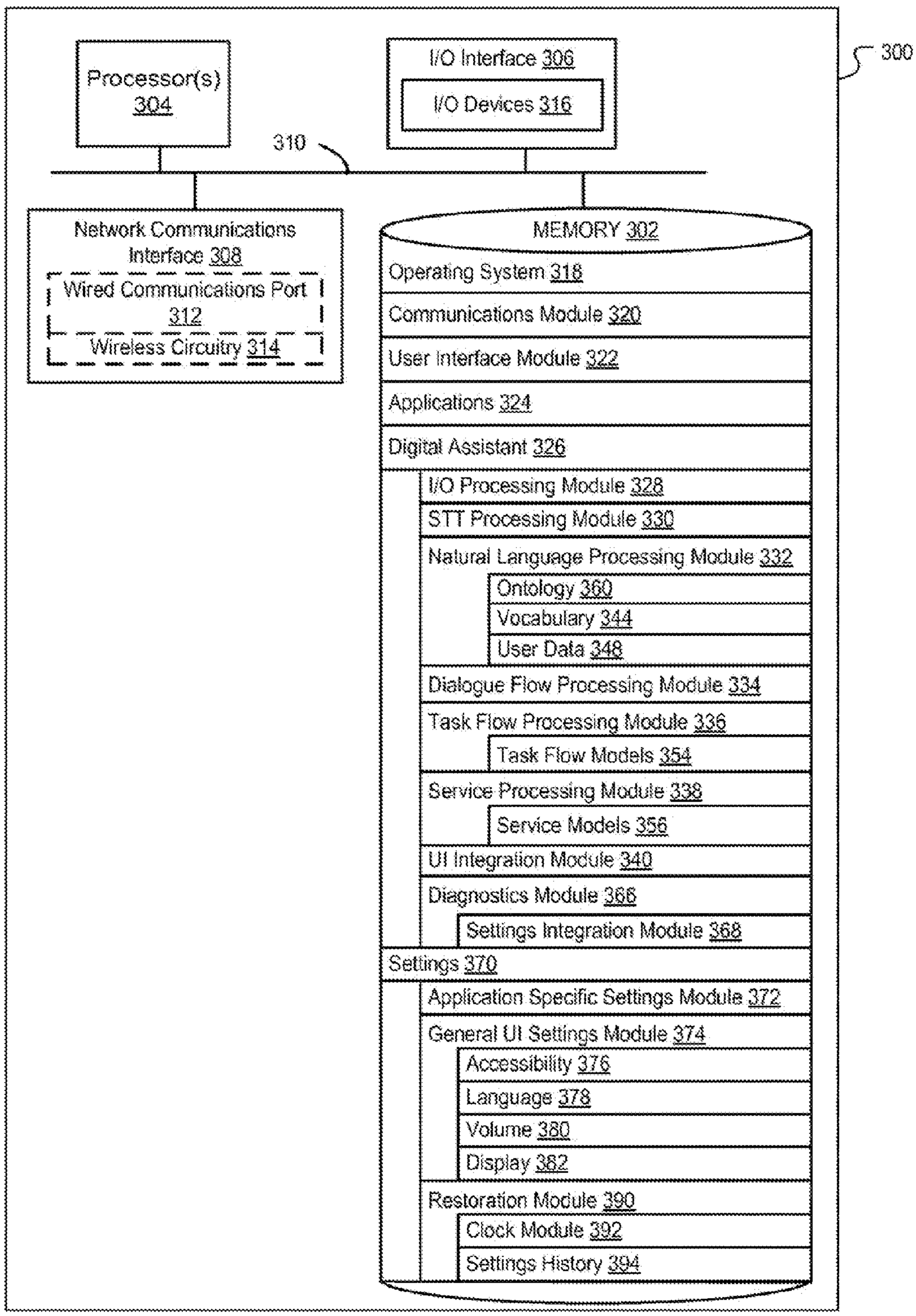

300
Processor(s) 304
I/O Interface 306
I/O Devices 316
310
Network Communications Interface 308
Wired Communications Port 312
Wireless Circuitry 314
MEMORY 302
Operating System 318
Communications Module 320
User Interface Module 322
Applications 324
Digital Assistant 326
I/O Processing Module 328
STT Processing Module 330
Natural Language Processing Module 332
Ontology 360
Vocabulary 344
User Data 348
Dialogue Flow Processing Module 334
Task Flow Processing Module 336
Task Flow Models 354
Service Processing Module 338
Service Models 356
UI Integration Module 340
Diagnostics Module 366
Settings Integration Module 368
Settings 370
Application Specific Settings Module 372
General UI Settings Module 374
Accessibility 376
Language 378
Volume 380
Display 382
Restoration Module 390
Clock Module 392
Settings History 394

Figure 3A

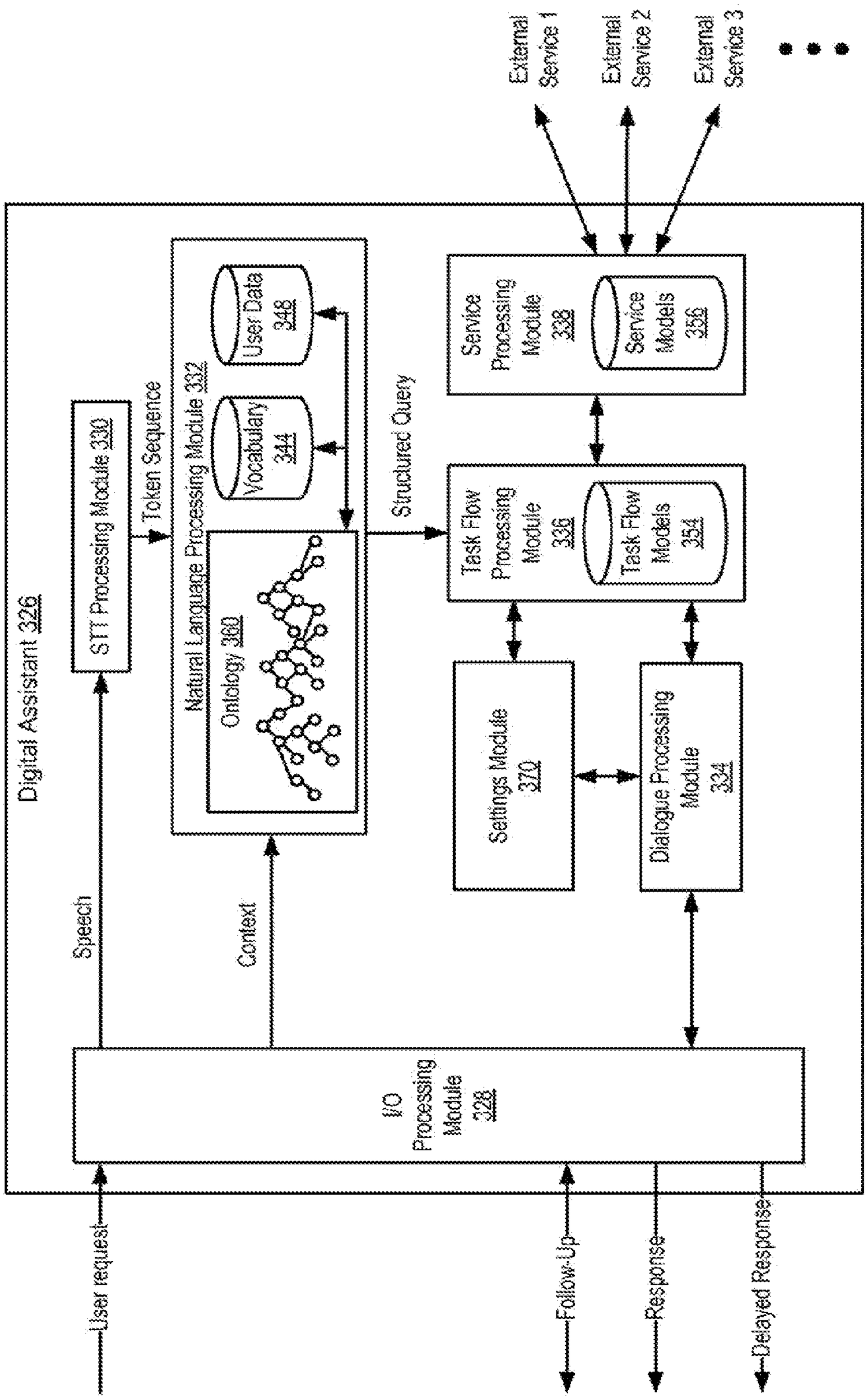

External Service 1
External Service 2
External Service 3
Digital Assistant 326
STT Processing Module 330
Token Sequence
Natural Language Processing Module 332
Ontology 360
Vocabulary 344
User Data 348
Structured Query
Task Flow Processing Module 336
Task Flow Models 354
Service Processing Module 338
Service Models 356
Settings Module 370
Dialogue Processing Module 334
Speech
Context
I/O Processing Module 328
User request
Follow-Up
Response
Delayed Response

Figure 3B

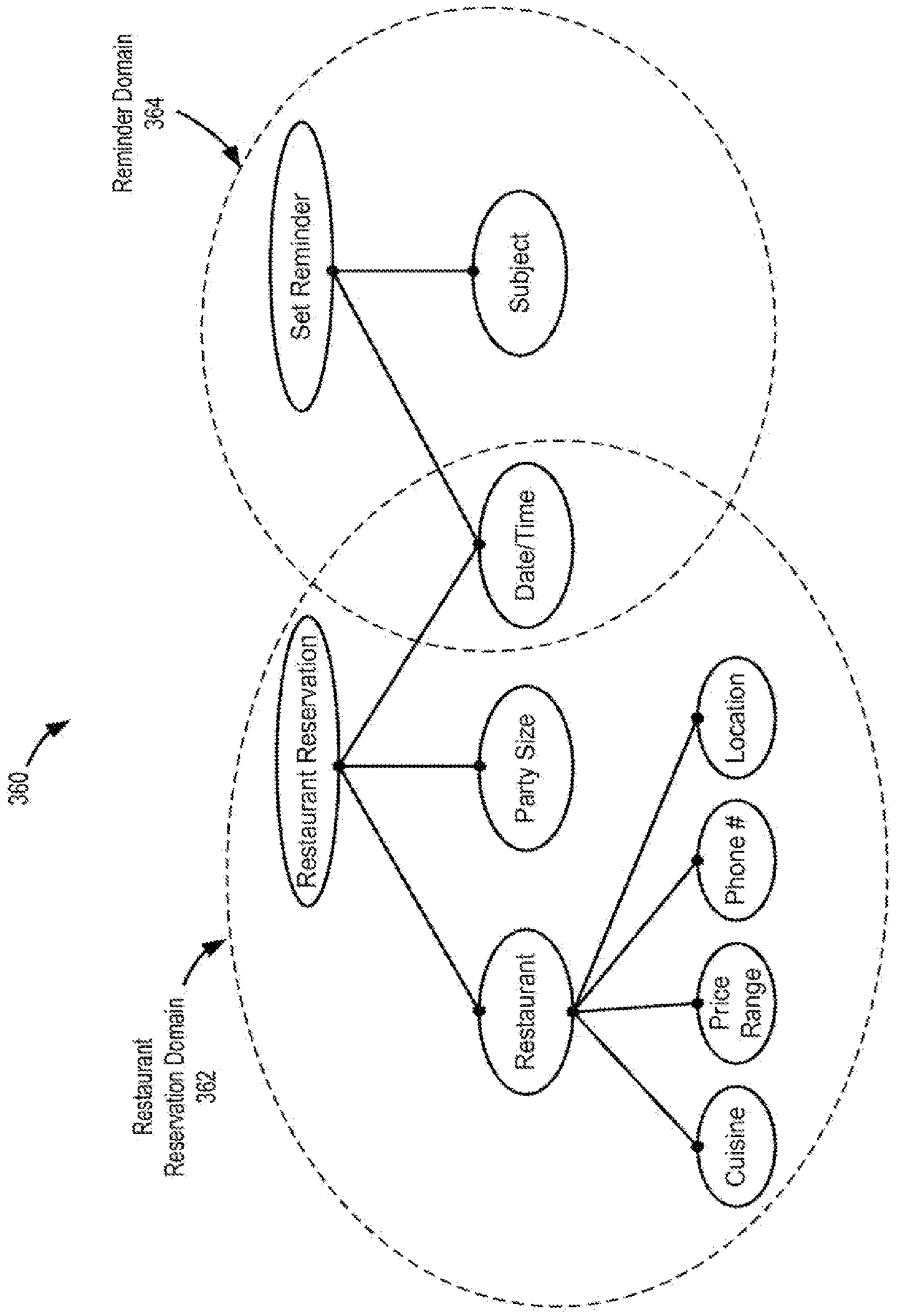

360
Reminder Domain
364
Set Reminder
Subject
Date/Time
Restaurant Reservation
Party Size
Restaurant
Location
Phone #
Price Range
Cuisine
Restaurant Reservation Domain
362

Figure 3C

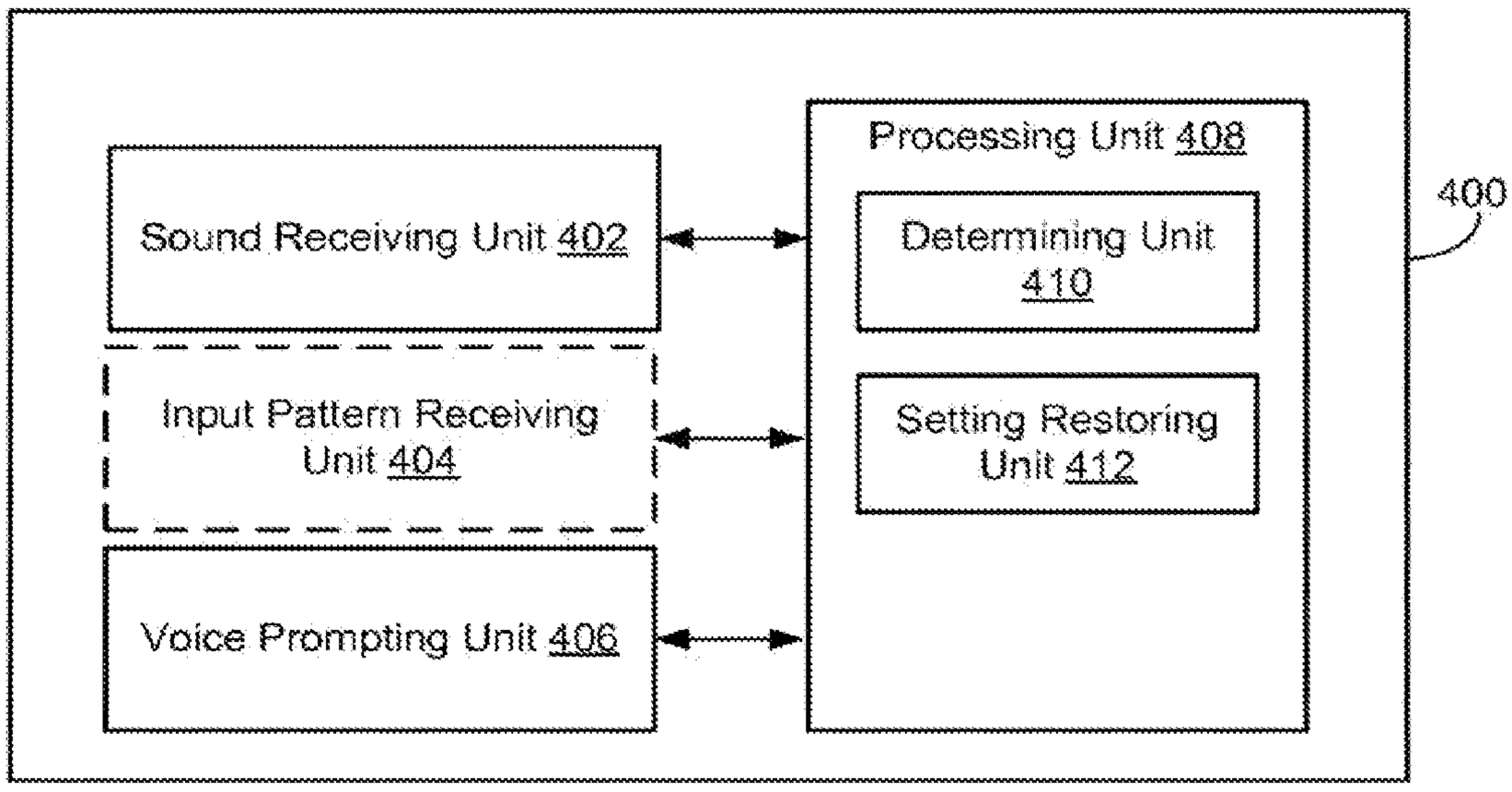

Sound Receiving Unit 402
Input Pattern Receiving Unit 404
Voice Prompting Unit 406
Processing Unit 408
Determining Unit 410
Setting Restoring Unit 412
400

Figure 4

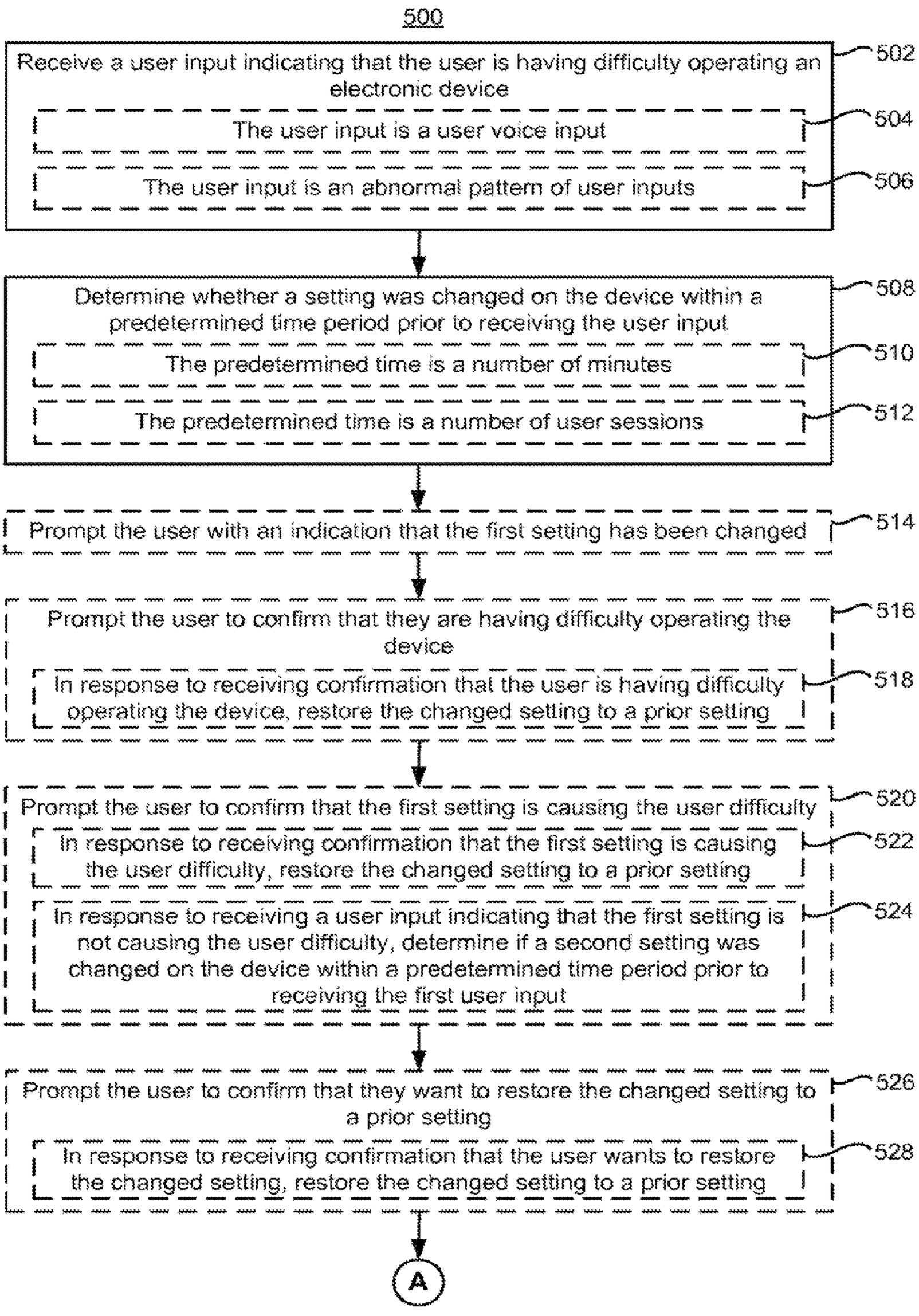

500
Receive a user input indicating that the user is having difficulty operating an electronic device
502
The user input is a user voice input
504
The user input is an abnormal pattern of user inputs
506
Determine whether a setting was changed on the device within a predetermined time period prior to receiving the user input
508
The predetermined time is a number of minutes
510
The predetermined time is a number of user sessions
512
Prompt the user with an indication that the first setting has been changed
514
Prompt the user to confirm that they are having difficulty operating the device
516
In response to receiving confirmation that the user is having difficulty operating the device, restore the changed setting to a prior setting
518
Prompt the user to confirm that the first setting is causing the user difficulty
520
In response to receiving confirmation that the first setting is causing the user difficulty, restore the changed setting to a prior setting
522
In response to receiving a user input indicating that the first setting is not causing the user difficulty, determine if a second setting was changed on the device within a predetermined time period prior to receiving the first user input
524
Prompt the user to confirm that they want to restore the changed setting to a prior setting
526
In response to receiving confirmation that the user wants to restore the changed setting, restore the changed setting to a prior setting
528
A

Figure 5A

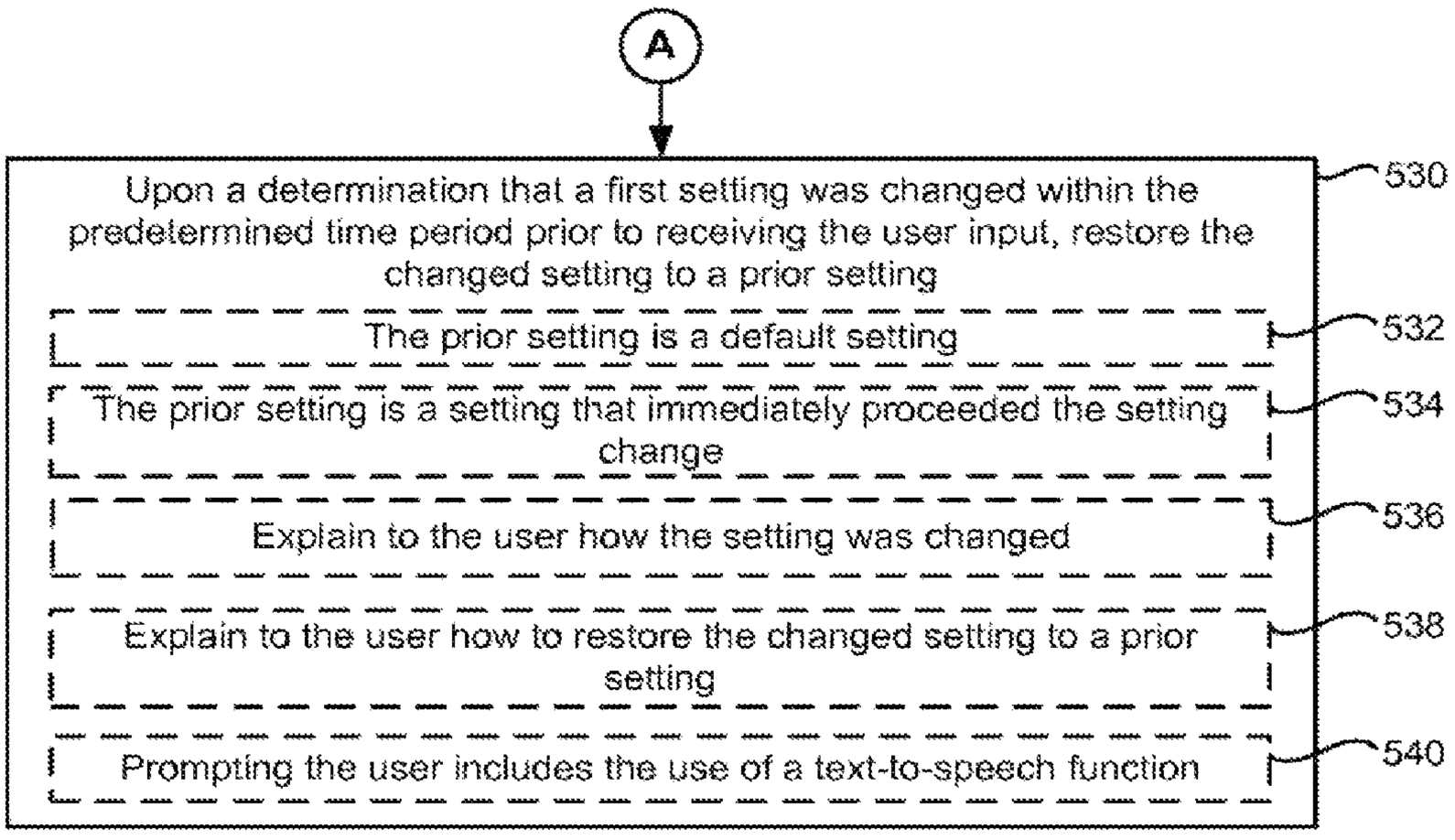

A
Upon a determination that a first setting was changed within the predetermined time period prior to receiving the user input, restore the changed setting to a prior setting
530
The prior setting is a default setting
532
The prior setting is a setting that immediately proceeded the setting change
534
Explain to the user how the setting was changed
536
Explain to the user how to restore the changed setting to a prior setting
538
Prompting the user includes the use of a text-to-speech function
540

Figure 5B

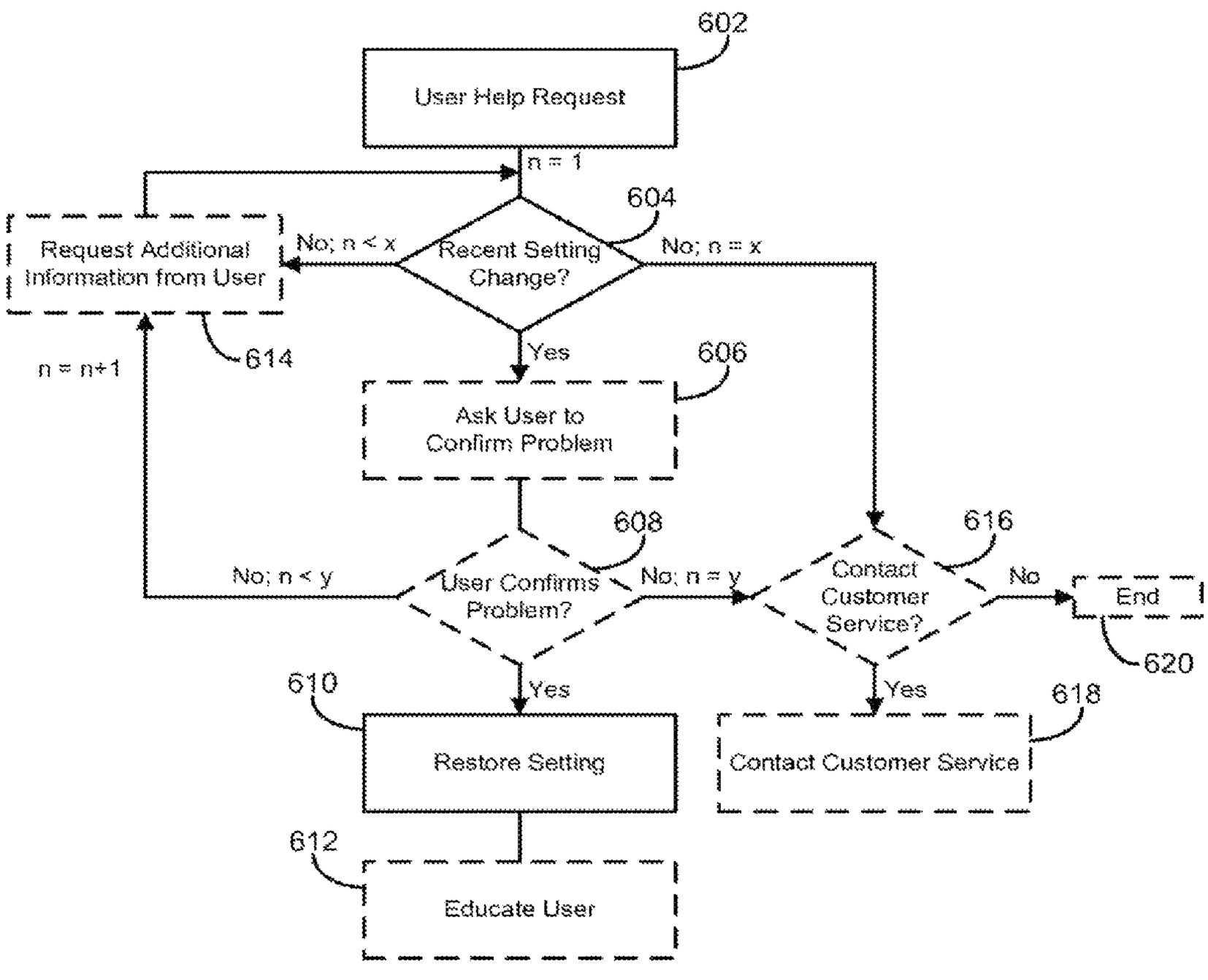

600
602
User Help Request
n = 1
604
Recent Setting Change?
No; n < x
Request Additional Information from User
614
n = n+1
No; n = x
Yes
606
Ask User to Confirm Problem
608
User Confirms Problem?
No; n < y
No; n = y
610
Restore Setting
612
Educate User
616
Contact Customer Service?
No
End
620
Yes
618
Contact Customer Service

Figure 6

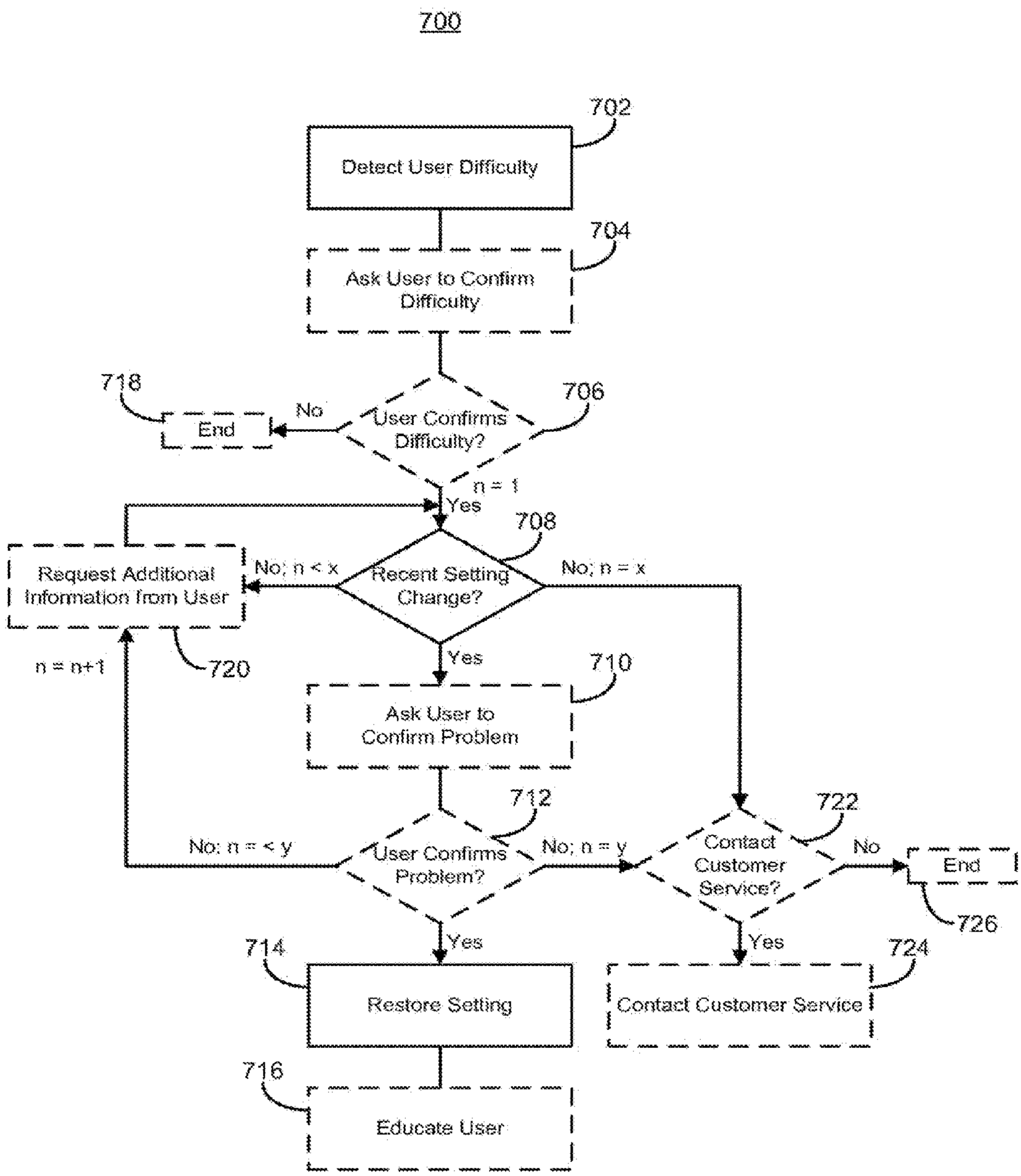

700
702
Detect User Difficulty
704
Ask User to Confirm Difficulty
718
End
No
706
User Confirms Difficulty?
n = 1
Yes
708
Request Additional Information from User
No; n < x
Recent Setting Change?
No; n = x
n = n+1
720
Yes
710
Ask User to Confirm Problem
712
No; n = < y
User Confirms Problem?
No; n = y
722
Contact Customer Service?
No
End
726
Yes
714
Restore Setting
Yes
724
Contact Customer Service
716
Educate User

Figure 7

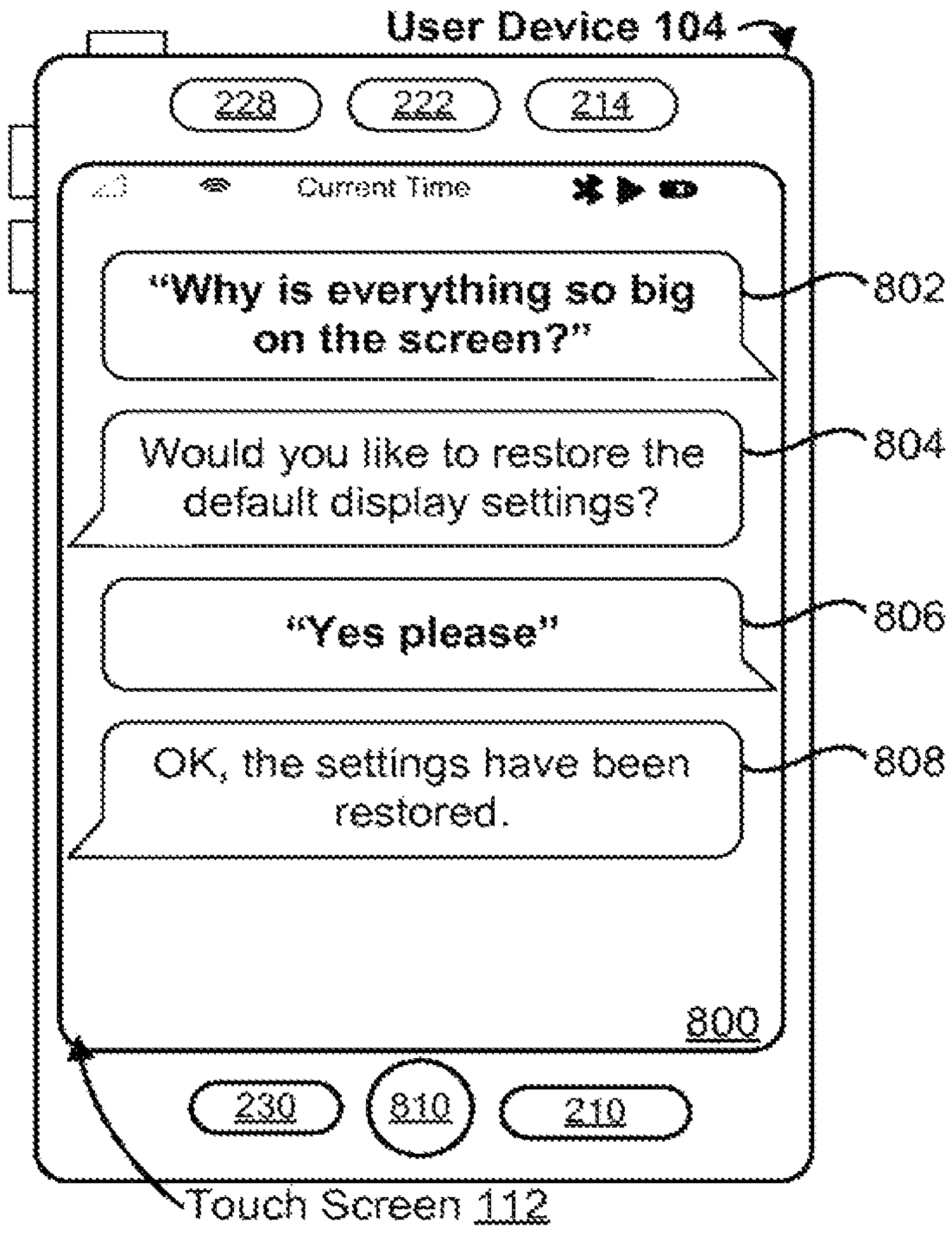

User Device 104
228
222
214
Current Time
"Why is everything so big on the screen?"
802
Would you like to restore the default display settings?
804
"Yes please"
806
OK, the settings have been restored.
808
800
230
810
210
Touch Screen 112

Figure 8

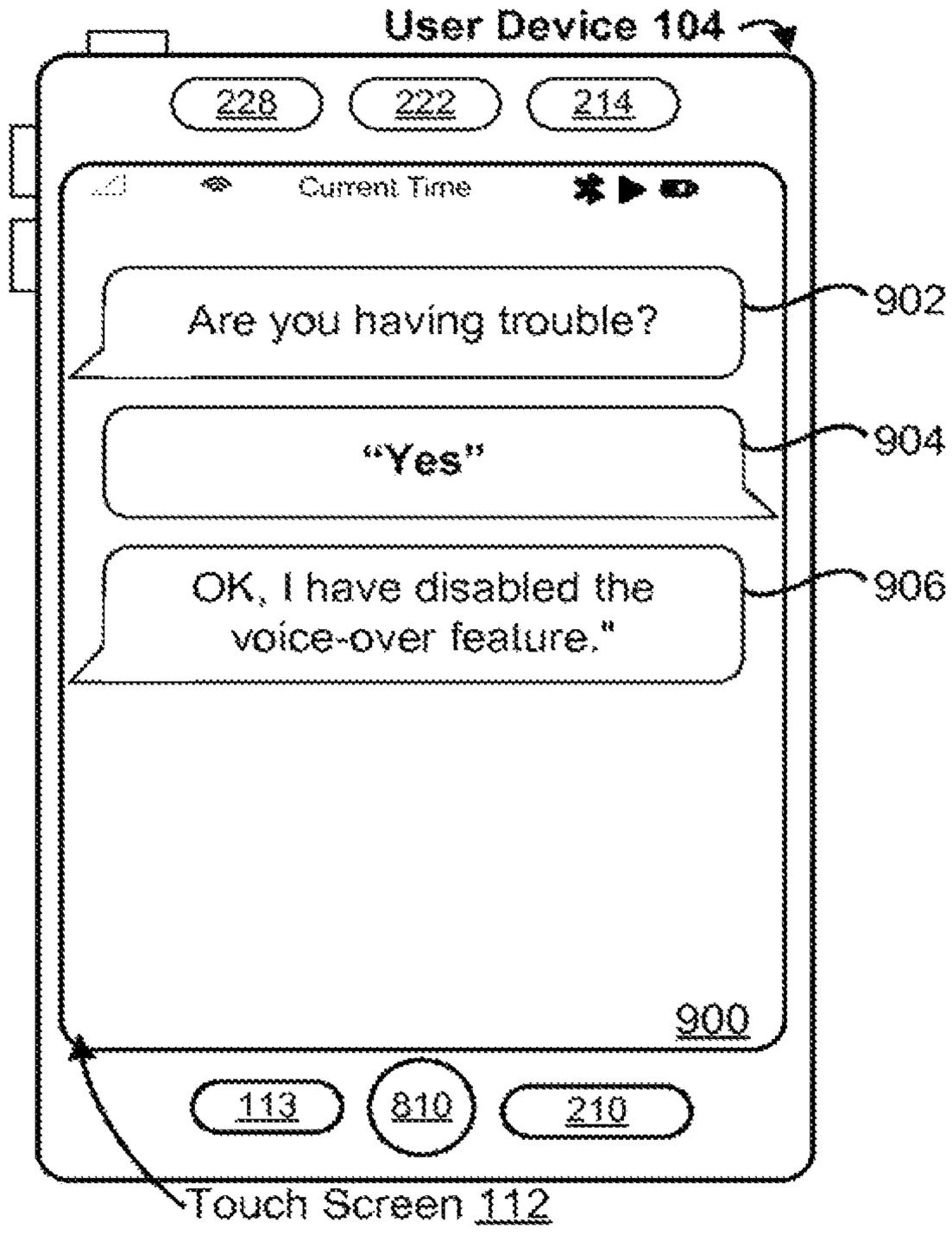

User Device 104
228
222
214
Current Time
Are you having trouble?
902
"Yes"
904
OK, I have disabled the voice-over feature."
906
900
113
810
210
Touch Screen 112

Figure 9

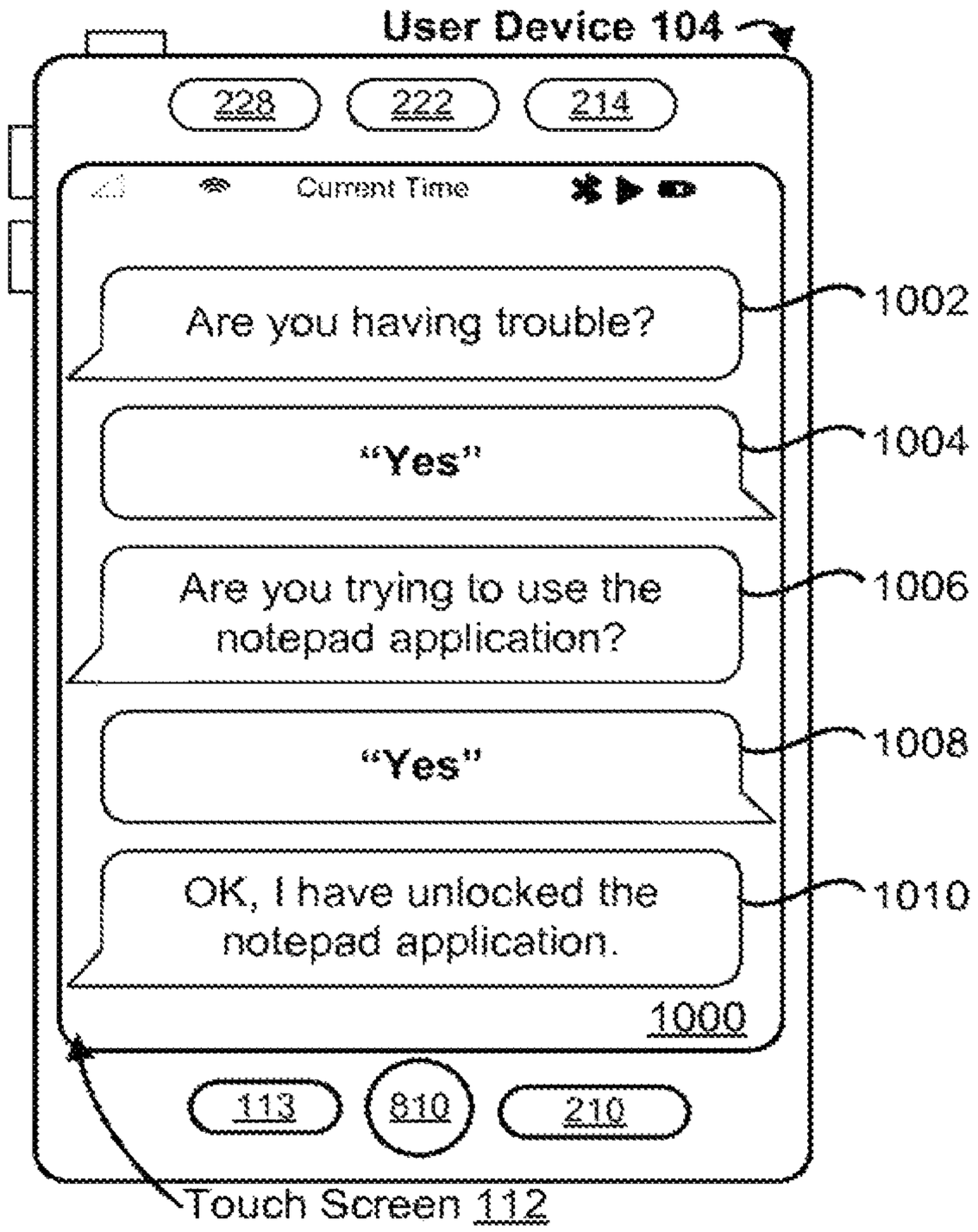

User Device 104
228
222
214
Current Time
Are you having trouble?
1002
"Yes"
1004
Are you trying to use the notepad application?
1006
"Yes"
1008
OK, I have unlocked the notepad application.
1010
1000
113
810
210
Touch Screen 112

Figure 10

VOICE CONTROL TO DIAGNOSE INADVERTENT ACTIVATION OF ACCESSIBILITY FEATURES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 61/785,853, filed on Mar. 14, 2013, entitled VOICE CONTROL TO DIAGNOSE INADVERTENT ACTIVATION OF ACCESSIBILITY FEATURES, which is hereby incorporated by reference in its entity for all purposes.

TECHNICAL FIELD

The disclosed implementations relate generally to digital assistants, and more specifically to a method and system for diagnosing an inadvertent activation of a user interface setting and restoring a prior user interface setting.

BACKGROUND

Accessibility features provide solutions that allow the elderly, young children, or people with disabilities to operate electronic devices. For example, voice-over technology provides advanced screen-reading technology allowing visually impaired individuals to hear a spoken description of what's onscreen and control their electronic device using only the keyboard. Screen magnification features also assist visually impaired individuals to operate electronic devices by magnifying the display or portions of the display up to or beyond 20-times normal resolution. Slow key technology assists individuals having physical or motor-skill challenges with typing by adding a delay between when a key is pressed and when the action is accepted, reducing the chance of mistake. Sticky key technology also assists individuals having physical or motor-skill challenges by allowing key combinations (e.g., chords) to be entered sequentially, rather than simultaneously.

While these features are important for users who know how to use them, they can be disorienting for users who do not know how to operate them properly. Often, these accessibility features completely change the normal modes of interaction familiar to users of the electronic device. For example, screen reading technology changes the function of the keyboard such that individual keys control a screen reader, rather than cause the input of text. Other features change the normal output of the device. For example, screen magnification technologies magnify portions or the entirety of a user interface display in Fashions that may be unintelligible to a user not accustomed to the function.

Inadvertent activation often leaves users with few options other than to call customer service, as they do not know how to deactivate these features. Conventionally, there are no alternative modes of interacting with the electronic device that the user can use in all circumstances (e.g., independent of the status of user interface settings such as accessibility features) to turn off accidentally invoked accessibility features. Thus, it would be beneficial to provide methods and systems that can identify when a user is having difficulty operating an electronic device, caused by a change in a user interface setting, e.g., activation of an accessibility feature, and allow the user to restore changed user interface settings.

SUMMARY

Many electronic devices allow a user to customize a user interface to match their individual needs and preferences.

For example, accessibility features are available that allow people with disabilities to use electronic devices such as digital music players, smart phones, tablet computers, laptops, and desktop computers. These accessibility features change the way in which the user interacts with the device, for example, by magnifying the display of a graphical user interface, inactivating certain input elements, or providing audible feedback rather than, or in addition to, visual feedback. However, because these features alter the way that the user interacts with the electronic device, disabling these features may require user inputs that are not intuitive and/or very different from the way a user typically interacts with the device. Furthermore, users who inadvertently activate these features may not be familiar with how to interact with the device after activation, and may encounter difficulty performing otherwise routine tasks afterwards.

Accordingly, there is a need for electronic devices with faster and more intuitive methods for diagnosing inadvertent activation of a user interface setting, such as an accessibility feature, and for restoring a prior user interface setting. Such methods may complement or replace conventional methods for diagnosing inadvertent activation of a user interface setting and restoring a prior user interface setting. Such methods and systems reduce the cognitive burden on a user and produce a more efficient human-machine interface.

To satisfy these and other needs, methods and systems are provided here that utilize voice-based assistants as an alternative mode of interacting with an electronic device, regardless of active user interface settings. Recently, voice-based digital assistants, such as APPLE's SIRI, have been introduced into the marketplace to handle various tasks such as web searching and navigation. One advantage of such voice-based digital assistants is that users can interact with a device in a hands-free manner without handling or even looking at the device. Hands-Free operation can be particularly beneficial when a person cannot, or should not, physically handle a device, such as when they are driving.

Here, voice-based digital assistants are used as a reliable method for interacting with an electronic device, regardless of the active user interface settings. Using the methods and systems provided herein, these voice-based digital assistants allow a user to ask what is wrong with their electronic device through spoken words. For example, a user can ask the voice-based assistant questions such as: "Why is my screen zoomed-in?" "Why is my computer talking to me?" "Why doesn't my keyboard work?" The digital assistant then checks the status of user interface settings, such as accessibility features, that may be disrupting the normal operation of the electronic device, and restores a prior user interface environment that is more familiar to the user. Alternatively or additionally, the voice-based digital assistant can educate the user as to why their electronic device is functioning in a particular manner; how to avoid activating these features in the future; and how to disable these features when they are activated. Thus, even when user interface settings which completely change the normal modes of user-device interaction are active (e.g., accessibility features), users will have a familiar and reliable means for restoring familiar user interface settings.

The implementations described below provide systems and methods for diagnosing inadvertent activation of a user interface setting and restoring a prior user interface setting.

Some implementations provide a method performed at an electronic device for diagnosing inadvertent activation of a user interface setting on the electronic device. The method includes receiving a user input indicating that the user is having difficulty operating the electronic device and deter-

mining whether a setting was changed on the device within a predetermined time period prior to receiving the user input. The method also includes, upon a determination that a first setting was changed within the predetermined time period prior to receiving the user input, restoring the changed setting to a prior setting.

Some implementations provide an electronic device that includes a processing unit configured to detect a user input indicative that the user is having difficulty operating the electronic device. The processing unit is also configured to determine whether a setting was changed on the device within a predetermined time period prior to the detection of the user input. The processor is further configured to, upon a determination that a first setting was changed within the predetermined time period prior to detection of the user input, restore the changed setting to a prior setting.

In accordance with some implementations, a computer-readable storage medium (e.g., a non-transitory computer readable storage medium) is provided, the computer-readable storage medium storing one or more programs for execution by one or more processors of an electronic device, the one or more programs including instructions for performing any of the methods described herein,

In accordance with some implementations, an electronic device (e.g., a mobile electronic device) is provided that comprises means for performing any of the methods described herein.

In accordance with some implementations, an electronic device (e.g., a portable electronic device) is provided that comprises a processing unit configured to perform any of the methods described herein.

In accordance with some implementations, an electronic device (e.g., a portable electronic device) is provided that comprises one or more processors and memory storing one or more programs for execution by the one or more processors, the one or more programs including instructions for performing any of the methods described herein.

In accordance with some implementations, an information processing apparatus for use in an electronic device is provided, the information processing apparatus comprising means for performing any of the methods described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating an environment in which a digital assistant operates in accordance with some implementations.

FIG. **2** is a block diagram illustrating a digital assistant client system in accordance with some implementations.

FIG. **3**A is a block diagram illustrating a standalone digital assistant system or a digital assistant server system in accordance with some implementations.

FIG. **3**B is a block diagram illustrating functions of the digital assistant shown in FIG. **3**A in accordance with some implementations.

FIG. **3**C is a network diagram illustrating a portion of an ontology in accordance with some implementations.

FIG. **4** is a block diagram of an electronic device in accordance with some implementations.

FIGS. **5**A-**5**B are flow diagrams illustrating a method of diagnosing inadvertent activation of a user interface setting and restoring a prior user interface setting in accordance with some implementations.

FIG. **6** is a flow chart illustrating exemplary processing steps for facilitating diagnosis of inadvertent activation of a user interface setting and restoring a prior user interface setting, when initiated by a user, where x and y are predetermined thresholds, in accordance with some implementations.

FIG. **7** is a flow chart illustrating exemplary processing steps for facilitating diagnosis of inadvertent activation of a user interface setting and restoring a prior user interface setting, when initiated by an electronic device, where x and y are predetermined thresholds, in accordance with some implementations.

FIG. **8** is a screen-shot illustrating exemplary user-device interactions facilitating diagnosis of inadvertent activation of a user interface setting and restoring a prior user interface setting, when initiated by a user, in accordance with some implementations.

FIG. **9** is a screen-shot illustrating exemplary user-device interactions facilitating diagnosis of inadvertent activation of a user interface setting and restoring a prior user interface setting, when initiated by an electronic device, in accordance with some implementations.

FIG. **10** is a screen-shot illustrating exemplary user-device interactions facilitating diagnosis of inadvertent activation of a user interface setting and restoring a prior user interface setting, when initiated by an electronic device, in accordance with some implementations.

Like reference numerals refer to corresponding parts throughout the drawings.

DESCRIPTION OF IMPLEMENTATIONS

FIG. **1** is a block diagram of an operating environment **100** of a digital assistant according to some implementations. The terms "digital assistant," "virtual assistant," "intelligent automated assistant," "voice-based digital assistant," or "automatic digital assistant," refer to any information processing system that interprets natural language input in spoken and/or textual Form to infer user intent (e.g., identify a task type that corresponds to the natural language input), and performs actions based on the inferred user intent (e.g., perform a task corresponding to the identified task type). For example, to act on a inferred user intent, the system can perform one or more of the Following: identifying a task flow with steps and parameters designed to infer user intent (e.g., identifying a task type), inputting specific requirements from the inferred user intent into the task flow, executing the task flow by invoking programs, methods, services, APIs, or the like (e.g., sending a request to a service provider); and generating output responses to the user in an audible (e.g., speech) and/or visual form.

Specifically, once initiated, a digital assistant system is capable of accepting a user request at least partially in the form of a natural language command, request, statement, narrative, and/or inquiry. Typically, the user request seeks either an informational answer or performance of a task by the digital assistant system. A satisfactory response to the user request is generally either provision of the requested informational answer, performance of the requested task, or a combination of the two. For example, a user may ask the digital assistant system a question, such as "Where am I right now?" Based on the user's current location, the digital assistant may answer, "You are in Central Park near the west gate." The user may also request the performance of a task, for example, by stating "Please invite my friends to my girlfriend's birthday party next week." In response, the digital assistant may acknowledge the request by generating a voice output, "Yes, right away," and then send a suitable calendar invite from the user's email address to each of the user' friends listed in the user's electronic address book or

contact list. There are numerous other ways of interacting with a digital assistant to request information or performance of various tasks. In addition to providing verbal responses and taking programmed actions, the digital assistant can also provide responses in other visual or audio forms (e.g., as text, alerts, music, videos, animations, etc.).

As shown in FIG. **1**, in some implementations, a digital assistant system is implemented according to a client-server model. The digital assistant system includes a client-side portion (e.g., **102***a* and **102***b*) (hereafter "digital assistant (DA) client **102**") executed on a user device (e.g., **104***a* and **104***b*), and a server-side portion **106** (hereafter "digital assistant (DA) server **106**") executed on a server system **108**, The DA client **102** communicates with the DA server **106** through one or more networks **110**. The DA client **102** provides client-side functionalities such as user-facing input and output processing and communications with the DA server **106**. The DA server **106** provides server-side functionalities for any number of DA clients **102** each residing on a respective user device **104** (also called a client device or electronic device).

In some implementations, the DA server **106** includes a client-facing I/O interface **112**, one or more processing modules **114**, data and models **116**, an U0 interface to external services **118**, and, optionally, a settings history module **140**. The client-facing I/O interface facilitates the client-facing input and output processing for the digital assistant server **106**. The one or more processing modules **114** utilize the data and models **116** to determine the user's intent based on natural language input and perform task execution based on the inferred user intent. Settings history module **140** creates tags in accordance with a user interface setting change on user device **104**, and stores tags in association with a user interface setting change on user device **104**.

In some implementations, the DA server **106** communicates with external services **120** (e.g., navigation service(s) **122-1**, messaging service(s) **122-2**, information service(s) **122-3**, calendar service **122-4**, telephony service **122-5**, restoration service(s) **122-6**, etc.) through the network(s) **110** for task completion or information acquisition. The I/O interface to the external services **118** facilitates such communications.

Examples of the user device **104** include, but are not limited to, a handheld computer, a personal digital assistant (PDA), a tablet computer, a laptop computer, a desktop computer, a cellular telephone, a smartphone, an enhanced general packet radio service (EGPRS) mobile phone, a media player, a navigation device, a game console, a television, a remote control, or a combination of any two or more of these data processing devices or any other suitable data processing devices. More details on the user device **104** are provided in reference to an exemplary user device **104** shown in FIG. **2**.

Examples of the communication network(s) **110** include local area networks (LAN) and wide area networks (WAN), e.g., the Internet. The communication network(s) **110** may be implemented using any known network protocol, including various wired or wireless protocols, such as Ethernet, Universal Serial Bus (USB), FIREWIRE, Global System for Mobile Communications (GSM), Enhanced Data GSM Environment (EDGE), code division multiple access (CDMA), time division multiple access (TDMA), Bluetooth, Wi-Fi, voice over Internet Protocol (VoIP), Wi-MAX, or any other suitable communication protocol.

The server system **108** can be implemented on at least one data processing apparatus and/or a distributed network of computers. In some implementations, the server system **108** also employs various virtual devices and/or services of third-party service providers (e.g., third-party cloud service providers) to provide the underlying computing resources and/or infrastructure resources of the server system **108**.

Although the digital assistant system shown in FIG. **1** includes both a client side portion (e.g., the DA client **102**) and a server-side portion (e.g., the DA server **106**), in some implementations, a digital assistant system refers only to the server-side portion (e.g., the DA server **106**). In some implementations, the functions of a digital assistant can be implemented as a standalone application installed on a user device. In addition, the divisions of functionalities between the client and server portions of the digital assistant can vary in different implementations. For example, in some implementations, the DA client **102** is a thin-client that provides only user-facing input and output processing functions, and delegates all other functionalities of the digital assistant to the DA server **106**. In some other implementations, the DA client **102** is configured to perform or assist one or more functions of the DA server **106**.

FIG. **2** is a block diagram of a user device **104** in accordance with some implementations. The user device **104** includes a memory interface **202**, one or more processors **204**. and a peripherals interface **206**. The various components in the user device **104** are coupled by one or more communication buses or signal lines. The user device **104** includes various sensors. subsystems, and peripheral devices that are coupled to the peripherals interface **206**. The sensors, subsystems, and peripheral devices gather information and/or facilitate various functionalities of the user device **104**.

For example, in some implementations, a motion sensor **210** (e.g., an accelerometer), a light sensor **212**, a GPS receiver **213**, a temperature sensor, and a proximity sensor **214** are coupled to the peripherals interface **206** to facilitate orientation, light, and proximity sensing functions. In some implementations, other sensors **216**, such as a biometric sensor, barometer, and the like, are connected to the peripherals interface **206**, to facilitate related functionalities.

In some implementations, the user device **104** includes a camera subsystem **220** coupled to the peripherals interface **206**. In some implementations, an optical sensor **222** of the camera subsystem **220** Facilitates camera functions, such as taking photographs and recording video clips. In some implementations, the user device **104** includes one or more wired and/or wireless communication subsystems **224** provide communication functions. The communication subsystems **224** typically includes various communication ports, radio frequency receivers and transmitters, and/or optical (e.g., infrared) receivers and transmitters. In some implementations, the user device **104** includes an audio subsystem **226** coupled to one or more speakers **228** and one or more microphones **230** to facilitate voice-enabled functions, such as voice recognition, voice replication, digital recording, and telephony functions.

In some implementations, an I/O subsystem **240** is also coupled to the peripheral interfaces **206**. In some implementations, the user device **104** includes a touch screen **246**, and the I/O subsystem **240** includes a touch screen controller **242** coupled to the touch screen **246**. When the user device **104** includes the touch screen **246** and the touch screen controller **242**, the touch screen **246** and the touch screen controller **242** are typically configured to, for example, detect contact and movement or break thereof using any of a plurality of touch sensitivity technologies, such as capacitive, resistive, infrared, surface acoustic wave technologies, proximity sen-

sor arrays, and the like. In some implementations, the user device **104** includes a display that does not include a touch-sensitive surface. In some implementations, the user device **104** includes a separate touch-sensitive surface. In some implementations, the user device **104** includes other input controller(s) **244**. When the user device **104** includes the other input controller(s) **244**, the other input controller(s) **244** are typically coupled to other input/control devices **248**, such as one or more buttons (e.g., home button **810**), rocker switches, thumb-wheel, infrared port, USB port, and/or a pointer device such as a stylus.

The memory interface **202** is coupled to memory **250**. In some implementations, memory **250** includes a non-transitory computer readable medium, such as high-speed random access memory and/or non-volatile memory (e.g., one or more magnetic disk storage devices, one or more flash memory devices, one or more optical storage devices, and/or other non-volatile solid-state memory devices).

In some implementations, memory **250** stores an operating system **252**, a communications module **254**, a graphical user interface module **256**, a sensor processing module **258**, a phone module **260**, and applications **262**, and a subset or superset thereof. The operating system **252** includes instructions for handling basic system services and for performing hardware dependent tasks. The communications module **254** facilitates communicating with one or more additional devices, one or more computers and/or one or more servers. The graphical user interface module **256** facilitates graphic user interface processing. The sensor processing module **258** facilitates sensor-related processing and functions (e.g., processing voice input received with the one or more microphones **230**). The phone module **260** facilitates phone-related processes and functions. The applications **262** facilitates various functionalities of user applications, such as electronic-messaging, web browsing, media processing, navigation, imaging and/or other processes and functions. In some implementations, the user device **104** stores in memory **250** one or more software applications **270-1** and **270-2** each associated with at least one of the external service providers.

As described above, in some implementations, memory **250** also stores client side digital assistant instructions (e.g., in a digital assistant client module **264**) and various user data **266** (e.g., user-specific vocabulary data, preference data, and/or other data such as the user's electronic address book or contact list, to-do lists, shopping lists, etc.) to provide the client-side functionalities of the digital assistant.

In various implementations, the digital assistant client module **264** is capable of accepting voice input, text input, touch input, and/or gestural input through various user interfaces (e.g., the I/O subsystem **240**) of the user device **104**. The digital assistant client module **264** is also capable of providing output in audio, visual, and/or tactile forms. For example, output can be provided as voice, sound, alerts, text messages, menus, graphics, videos, animations, vibrations, and/or combinations of two or more of the above. During operation, the digital assistant client module **264** communicates with the digital assistant server (e.g., the digital assistant server **106**, FIG. **1**) using the communication subsystems **224**.

In some implementations, the digital assistant mint module **264** utilizes various sensors, subsystems and peripheral devices to gather additional information from the surrounding environment of the user device **104** to establish a context associated with a user input. In some implementations, the digital assistant client module **264** provides the context information or a subset thereof with the user input to the digital assistant server (e.g., the digital assistant server **106**, FIG. **1**) to help infer the user's intent.

In some implementations, the context information that can accompany the user input includes sensor information, e.g., lighting, ambient noise, ambient temperature, images or videos of the surrounding environment, etc. In some implementations, the context information also includes the physical state of the device, e.g., device orientation, device location, device temperature, power level, speed, acceleration, motion patterns, cellular signals strength, etc. In some implementations, information related to the software state of the user device **106**, e.g., running processes, installed programs, past and present network activities, background services, error logs, resources usage, etc., of the user device **104** is also provided to the digital assistant server (e.g., the digital assistant server **106**, FIG. **1**) as context information associated with a user input.

In some implementations, the DA client module **264** selectively provides information (e.g., at least a portion of the user data **266**) stored on the user device **104** in response to requests from the digital assistant server. In some implementations, the digital assistant client module **264** also elicits additional input from the user via a natural language dialogue or other user interfaces upon request by the digital assistant server **106** (FIG. **1**). The digital assistant client module **264** passes the additional input to the digital assistant server **106** to help the digital assistant server **106** in intent deduction and/or fulfillment of the user's intent expressed in the user request.

In some implementations, memory **250** may include additional instructions or fewer instructions. Furthermore, various functions of the user device **104** may be implemented in hardware and/or in firmware, including in one or more signal processing and/or application specific integrated circuits, and the user device **104**, thus, need not include all modules and applications illustrated in FIG. **2**.

FIG. **3**A is a block diagram of an exemplary digital assistant system **300** (also referred to as the digital assistant) in accordance with some implementations. In some implementations, the digital assistant system **300** is implemented on a standalone computer system. In some implementations, the digital assistant system **300** is distributed across multiple computers. In some implementations, some of the modules and functions of the digital assistant are divided into a server portion and a client portion, where the client portion resides on a user device (e.g., the user device **104**) and communicates with the server portion (e.g., the server system **108**) through one or more networks, e.g., as shown in FIG. **1**. In some implementations, the digital assistant system **300** is an implementation of the server system **108** (and/or the digital assistant server **106**) shown in FIG. **1**. In some implementations, the digital assistant system **300** is implemented in a user device (e.g., the user device **104**, FIG. **1**), thereby eliminating the need for a client-server system. It should be noted that the digital assistant system **300** is only one example of a digital assistant system, and that the digital assistant system **300** may have more or fewer components than shown, may combine two or more components, or may have a different configuration or arrangement of the components. The various components shown in FIG. **3**A may be implemented in hardware, software, firmware, including one or more signal processing and/or application specific integrated circuits, or a combination of thereof.

The digital assistant system **300** includes memory **302**, one or more processors **304**, an input/output (I/O) interface **306**, and a network communications interface **308**. These

components communicate with one another over one or more communication buses or signal lines **310**.

In some implementations, memory **302** includes a non-transitory computer readable medium, such as high-speed random access memory and/or a non-volatile computer readable storage medium (e.g., one or more magnetic disk storage devices, one or more flash memory devices, one or more optical storage devices, and/or other non-volatile solid-state memory devices).

The I/O interface **306** couples input/output devices **316** of the digital assistant system **300**, such as displays, a keyboards, touch screens, and microphones, to the user interface module **322**. The I/O interface **306**, in conjunction with the user interface module **322**, receives user inputs (e.g., voice input, keyboard inputs, touch inputs, etc.) and processes them accordingly. In some implementations, when the digital assistant is implemented on a standalone user device, the digital assistant system **300** includes any of the components and I/O and communication interfaces described with respect to the user device **104** in FIG. **2** (e.g., one or more microphones **230**). In some implementations, the digital assistant system **300** represents the server portion of a digital assistant implementation, and interacts with the user through a client-side portion residing on a user device (e.g., the user device **104** shown in FIG. **2**).

In some implementations, the network communications interface **30**K includes wired communication port(s) **312** and/or wireless transmission and reception circuitry **314**. The wired communication port(s) receive and send communication signals via one or more wired interfaces, e.g., Ethernet, Universal Serial Bus (USB), FIREWIRE, etc. The wireless circuitry **314** typically receives and sends RF signals and/or optical signals from/to communications networks and other communications devices. The wireless communications may use any of a plurality of communications standards, protocols and technologies, such as GSM, EDGE, CDMA, TDMA, Bluetooth, Wi-Fi, VoIP, Wi-MAX, or any other suitable communication protocol. The network communications interface **30**K enables communication between the digital assistant system **300** with networks, such as the Internet, an intranet and/or a wireless network, such as a cellular telephone network, a wireless local area network (LAN) and/or a metropolitan area network (MAN), and other devices.

In some implementations, the non-transitory computer readable storage medium of memory **302** stores programs, modules, instructions, and data structures including all or a subset of: an operating system **318**, a communications module **320**, a user interface module **322**, one or more applications **324**, a digital assistant module **326**, and settings **370**. The one or more processors **304** execute these programs, modules, and instructions, and reads/writes from/to the data structures.

The operating system **318** (e.g., Darwin, RTXC, LINUX, UNIX, OS X, iOS, WINDOWS, or an embedded operating system such as VxWorks) includes various software components and/or drivers for controlling and managing general system tasks (e.g., memory management, storage device control, power management, etc.) and facilitates communications between various hardware, firmware, and software components.

The communications module **320** facilitates communications between the digital assistant system **300** with other devices over the network communications interface **308**. For example, the communication module **320** may communicate with the communications module **254** of the device **104** shown in FIG. **2**. The communications module **320** also includes various software components for handling, data received by the wireless circuitry **314** and/or wired communications port **312**.

In some implementations, the user interface module **322** receives commands and/or inputs from a user via the I/O interface **306** (e.g., from a keyboard, touch screen, and/or microphone), and provides user interface objects on a display.

The applications **324** include programs and/or modules that are configured to be executed by the one or more processors **304**. For example, if the digital assistant system is implemented on a standalone user device, the applications **324** may include user applications, such as games, a calendar application, a navigation application, or an email application. If the digital assistant system **300** is implemented on a server Farm, the applications **324** may include resource management applications, diagnostic applications, or scheduling applications, for example.

Memory **302** also stores the digital assistant module (or the server portion of a digital assistant) **326**. In some implementations, the digital assistant module **326** includes the following sub-modules, or a subset or superset thereof: an input/output processing module **328**, a speech-to-text (STT) processing module **330**, a natural language processing module **332**, a dialogue flow processing module **334**, a task flow processing module **336**, a service processing module **338**, and a diagnostic module **366**. Each of these processing modules has access to one or more of the following data and models of the digital assistant **326**, or a subset or superset thereof: ontology **360**, vocabulary index **344**, user data **348**, categorization module **349**, disambiguation module **350**, task flow models **354**, service models **356**, user interface integration module **340**, and settings integration module **368**.

In some implementations, using the processing modules (e.g., the input/output processing module **328**, the STT processing module **330**, the natural language processing module **332**, the dialogue flow processing module **334**, the task flow processing module **336**, the service processing module **338**, and/or the user interface integration module **340**), data, and models implemented in the digital assistant module **326**, the digital assistant system **300** performs at least some of the following: identifying a user's intent expressed in a natural language input received from the user, actively eliciting and obtaining information needed to Fully infer the user's intent (e.g., by disambiguating words, names, intentions, etc.); determining the task flow for fulfilling the inferred intent; and executing the task flow to fulfill the inferred intent. In some implementations, the digital assistant also takes appropriate actions when a satisfactory response was not or could not be provided to the user for various reasons.

In some implementations, as discussed below, the digital assistant system **300** identifies, From a natural language input, a user's intent to restore a user interface setting (e.g., to turn off an accessibility feature), and processes the natural language input so as to restore an appropriate user interface setting (e.g., turn off an appropriate accessibility feature).

The settings **370** facilitate user customization of methods executed by processor **304**, including methods that rely on global settings (e.g., system-wide volume, execution of sounds associated with common inputs, functionality of input receivers, display brightness, default language, or accessibility feature) and methods specific to an application (e.g., in-application volume, external content associated with an application, language associated with an application, or allowed functionalities of an application). In some imple-

mentations, the settings **370** include the following sub-modules, or a subset or superset thereof: application specific settings module **372**, general user interface settings module **374**, and restoration module **390**. Each of these settings modules has access to one or more of the Following data and models of the settings **370**, or a subset or superset thereof: accessibility **376**, language **378**, volume **380**, display **382**, clock module **392**, and settings history **394**.

As shown in FIG. **3**B, in some implementations, the I/O processing module **328** interacts with the user through the I/O devices **316** in FIG. **3**A or with a user del, ice (e.g., a user device **104** in FIG. **1**) through the network communications interface **308** in FIG. **3**A to obtain user input (e.g., a speech input) and to provide responses to the user input. The I/O processing module **328** optionally obtains context information associated with the user input from the user device, along with or shortly after the receipt of the user input. The context information includes user-specific data, vocabulary, and/or preferences relevant to the user input. In some implementations, the context information also includes software and hardware states (e.g., active settings) of the device (e.g., the user device **104** in FIG. **1**) at the time the user request is received, and/or information related to the surrounding environment of the user at the time that the user request was received. In some implementations, the I/O processing module **328** also sends follow-up questions to, and receives answers from, the user regarding the user request. In some implementations, when a user request is received by the I/O processing module **328** and the user request contains a speech input, the I/O processing module **328** forwards the speech input to the speech-to-text (STT) processing module **330** for speech-to-text conversions.

In some implementations, the speech-to-text processing module **330** receives speech input (e.g., a user utterance captured in a voice recording) through the I/O processing module **328**. In some implementations, the speech-to-text processing module **330** uses various acoustic and language models to recognize the speech input as a sequence of phonemes, and ultimately, a sequence of words or tokens written in one or more languages. The speech-to-text processing module **330** is implemented using any suitable speech recognition techniques, acoustic models, and language models, such as Hidden Markov Models, Dynamic Time Warping (DTW)-based speech recognition, and other statistical and/or analytical techniques. In some implementations, the speech-to-text processing can be performed at least partially by a third party service or on the user's device. Once the speech-to-text processing module **330** obtains the result of the speech-to-text processing (e.g., a sequence of words or tokens), it passes the result to the natural language processing module **332** for intent deduction.

The natural language processing module **332** ("natural language processor") of the digital assistant **326** takes the sequence of words or tokens ("token sequence") generated by the speech-to-text processing module **330**, and attempts to associate the token sequence with one or more "actionable intents" recognized by the digital assistant. As used herein, an "actionable intent" represents a task that can be performed by the digital assistant **326** and/or the digital assistant system **300** (FIG. **3**A), and has an associated task flow implemented in the task flow models **354**. The associated task flow is a series of programmed actions and steps that the digital assistant system **300** takes in order to perform the task. The scope of a digital assistant system's capabilities is dependent on the number and variety of task flows that have been implemented and stored in the task flow models **354**, or in other words, on the number and variety of "actionable intents" that the digital assistant system **300** recognizes. The effectiveness of the digital assistant system **300**, however, is also dependent on the digital assistant system's ability to infer the correct "actionable intent(s)" from the user request expressed in natural language.

In some implementations, in addition to the sequence of words or tokens obtained from the speech-to-text processing module **330**, the natural language processor **332** also receives context information associated with the user request (e.g., from the I/O processing module **328**). The natural language processor **332** optionally uses the context information to clarify, supplement, and/or further define the information contained in the token sequence received from the speech-to-text processing module **330**. The context information includes, for example, user preferences, hardware and/or software states of the user device (e.g., active settings), sensor information collected before, during, or shortly after the user request, prior interactions (e.g., dialogue) between the digital assistant and the user, and the like.

In some implementations, the natural language processing is based on an ontology **360**. The ontology **360** is a hierarchical structure containing a plurality of nodes, each node representing either an "actionable intent" or a "property" relevant to one or more of the "actionable intents" or other "properties." As noted above, an "actionable intent" represents a task that the digital assistant system **300** is capable of performing (e.g., a task that is "actionable" or can be acted on). A "property" represents a parameter associated with an actionable intent or a sub-aspect of another property. A linkage between an actionable intent node and a property node in the ontology **360** defines how a parameter represented by the property node pertains to the task represented by the actionable intent node.

In some implementations, the ontology **360** is made up of actionable intent nodes and property nodes. Within the ontology **360**, each actionable intent node is linked to one or more property nodes either directly or through one or more intermediate property nodes. Similarly, each property node is linked to one or more actionable intent nodes either directly or through one or more intermediate property nodes. For example, the ontology **360** shown in FIG. **3**C includes a "restaurant reservation" node, which is an actionable intent node. Property nodes "restaurant," "date/time" (for the reservation), and "party size" are each directly linked to the "restaurant reservation" node (i.e., the actionable intent node). In addition, property nodes "cuisine," "price range," "phone number," and "location" are sub-nodes of the property node "restaurant," and are each linked to the "restaurant reservation" node (i.e., the actionable intent node) through the intermediate property node "restaurant." For another example, the ontology **360** shown in FIG. **3**C also includes a "set reminder" node, which is another actionable intent node. Property nodes "date/time" (for the setting the reminder) and "subject" (for the reminder) are each linked to the "set reminder" node. Since the property "date/time" is relevant to both the task of making a restaurant reservation and the task of setting a reminder, the property node "date/time" is linked to both the "restaurant reservation" node and the "set reminder" node in the ontology **360**.

An actionable intent node, along with its linked concept nodes, may be described as a "domain." In the present discussion, each domain is associated with a respective actionable intent, and refers to the group of nodes (and the relationships there between) associated with the particular actionable intent. For example, the ontology **360** shown in FIG. **3**C' includes an example of a restaurant reservation

domain **362** and an example of a reminder domain **364** within the ontology **360**. The restaurant reservation domain includes the actionable intent node "restaurant reservation," property nodes "restaurant," "date/time," and "party size," and sub-property nodes "cuisine," "price range," "phone number," and "location." The reminder domain **364** includes the actionable intent node "set reminder," and property nodes "subject" and "date/time." In some implementations, the ontology **360** is made up of many domains. Each domain may share one or more property nodes with one or more other domains. For example, the "date/time" property node may be associated with many other domains (e.g., a scheduling domain, a travel reservation domain, a movie ticket domain, etc.), in addition to the restaurant reservation domain **362** and the reminder domain **364**.

While FIG. **3**C illustrates two exemplary domains within the ontology **360**, the ontology **360** may include other domains (or actionable intents), such as "initiate a phone call," "find directions," "schedule a meeting," "send a message," "provide an answer to a question," "restore a user interface setting," and so on. For example, a "send a message" domain is associated with a "send a message" actionable intent node, and may Further include property nodes such as "recipient(s)," "message type," and "message body." The property node "recipient" may be further defined, for example, by the sub-property nodes such as "recipient name" and "message address."

In some implementations, the ontology **360** includes all the domains (and hence actionable intents) that the digital assistant is capable of understanding and acting upon. In some implementations, the ontology **360** may be modified, such as by adding or-removing domains or nodes, or by modifying relationships between the nodes within the ontology **360**.

In some implementations, nodes associated with multiple related actionable intents may be clustered under a "super domain" in the ontology **360**. For example, a "travel" super-domain may include a cluster of property nodes and actionable intent nodes related to travels. The actionable intent nodes related to travels may include "airline reservation," "hotel reservation," "car rental," "get directions," "find points of interest," and so on. The actionable intent nodes under the same super domain (e.g., the "travels" super domain) may have many property nodes in common. For example, the actionable intent nodes for "airline reservation," "hotel reservation," "car rental," "get directions," "find points of interest" may share one or more of the property nodes "start location," "destination," "departure date/time," "arrival date/time," and "party size."

In some implementations, each node in the ontology **360** is associated with a set of words and/or phrases that are relevant to the property or actionable intent represented by the node. The respective set of words and/or phrases associated with each node is the so-called "vocabulary" associated with the node. The respective set of words and/or phrases associated with each node can be stored in the vocabulary index **344** (FIG. **3**B) in association with the property or actionable intent represented by the node. For example, returning to FIG. **3**B, the vocabulary associated with the node for the property of restaurant" may include words such as "food," "drinks," "cuisine," "hungry," "cat," "pizza," "fast food," "meal," and so on. For another example, the vocabulary associated with the node for the actionable intent of "initiate a phone call" may include words and phrases such as "call," "phone," "dial," "ring," "call this number," "make a call to," and so on. The vocabulary index **344** optionally includes words and phrases in different languages.

In some implementations, the natural language processor **332** shown in FIG. **3**B receives the token sequence (e.g., a text string) from the speech-to-text processing module **330**, and determines what nodes are implicated by the words in the token sequence. In some implementations, if a word or phrase in the token sequence is Found to be associated with one or more nodes in the ontology **360** (via the vocabulary index **344**), the word or phrase will "trigger" or "activate" those nodes. When multiple nodes are "triggered," based on the quantity and/or relative importance of the activated nodes, the natural language processor **332** will select one of the actionable intents as the task (or task type) that the user intended the digital assistant to perform. In some implementations, the domain that has the most "triggered" nodes is selected. In some implementations, the domain having the highest confidence value (e.g., based on the relative importance of its various triggered nodes) is selected. In some implementations, the domain is selected based on a combination of the number and the importance of the triggered nodes. In some implementations, additional factors are considered in selecting the node as well, such as whether the digital assistant system **300** has previously correctly interpreted a similar request from a user.

In some implementations, the digital assistant system **300** also stores names of specific entities in the vocabulary index **344**, so that when one of these names is detected in the user request, the natural language processor **332** will be able to recognize that the name refers to a specific instance of a property or sub-property in the ontology. In some implementations, the names of specific entities are names of businesses, restaurants, people, movies, and the like. In some implementations, the digital assistant system **300** can search and identify specific entity names from other data sources, such as the user's address book or contact list, a movies database, a musicians database, and/or a restaurant database. In some implementations, when the natural language processor **332** identifies that a word in the token sequence is a name of a specific entity (such as a name in the user's address book or contact list), that word is given additional significance in selecting the actionable intent within the ontology for the user request.

For example, when the words "Mr. Santo" are recognized from the user request, and the last name "Santo" is found in the vocabulary index **344** as one of the contacts in the user's contact list, then it is likely that the user request corresponds to a "send a message" or "initiate a phone call" domain. For another example, when the words "ABC' Café" are found in the user request, and the term "ABC Café" is Found in the vocabulary index **344** as the name of a particular restaurant in the user's city, then it is likely that the user request corresponds to a "restaurant reservation" domain.

User data **348** includes user-specific information, such as user-specific vocabulary, user preferences, user address, user's default and secondary languages, user's contact list, and other short-term or long-term information for each user. The natural language processor **332** can use the user-specific information to supplement the information contained in the user input to further define the user intent. For example, for a user request-invite my friends to my birthday party," the natural language processor **332** is able to access user data **348** to determine who the "friends" are and when and where the "birthday party" would be held, rather than requiring the user to provide such information explicitly in his/her request.

In some implementations, natural language processor **332** includes categorization module **349**. In some implementations, the categorization module **349** determines whether each of the one or more terms in a text string (e.g., corresponding to a speech input associated with a digital photograph) is one of an entity, an activity, or a location, as discussed in greater detail below. In some implementations, the categorization module **349** classifies each term of the one or more terms as one of an entity, an activity, or a location.

Once the natural language processor **332** identifies an actionable intent (or domain) based on the user request, the natural language processor **332** generates a structured query to represent the identified actionable intent. In some implementations, the structured query includes parameters for one or more nodes within the domain for the actionable intent, and at least some of the parameters are populated with the specific information and requirements specified in the user request. For example, the user may say "Make me a dinner reservation at a sushi place at 7." In this case, the natural language processor **332** may be able to correctly identify the actionable intent to be "restaurant reservation" based on the user input. According to the ontology, a structured query for a "restaurant reservation" domain may include parameters such as {Cuisine}, {Time}, {Date}, {Party Size}, and the like. Based on the information contained in the user's utterance, the natural language processor **332** may generate a partial structured query for the restaurant reservation domain, where the partial structured query includes the parameters {Cuisine="Sushi"} and {Time="7 pm"}. However, in this example, the user's utterance contains insufficient information to complete the structured query associated with the domain. Therefore, other necessary parameters such as {Party Size} and {Date} are not specified in the structured query based on the information currently available. In some implementations, the natural language processor **332** populates some parameters of the structured query with received context information. For example, if the user requested a sushi restaurant "near me," the natural language processor **332** may populate a {location} parameter in the structured query with CPS coordinates from the user device **104**.

In some implementations, the natural language processor **332** passes the structured query (including any completed parameters) to the task flow processing module **336** ("task flow processor"). The task flow processor **336** is configured to perform one or more of: receiving the structured query from the natural language processor **332**, completing the structured query, and performing the actions required to "complete" the user's ultimate request. In some implementations, the various procedures necessary to complete these tasks are provided in task flow models **354**. In some implementations, the task flow models **354** include procedures for obtaining additional information from the user, and task flows for performing actions associated with the actionable intent.

As described above, in order to complete a structured query, the task flow processor **336** may need to initiate additional dialogue with the user in order to obtain additional information, and/or disambiguate potentially ambiguous utterances. When such interactions are necessary, the task flow processor **336** invokes the dialogue processing module **334** ("dialogue processor") to engage in a dialogue with the user. In some implementations, the dialogue processing module **334** determines how (and/or when) to ask the user for the additional information, and receives and processes the user responses. In some implementations, the questions are provided to and answers are received From the users through the I/O processing module **328**. For example, the dialogue processing module **334** presents dialogue output to the user via audio and/or visual output, and receives input from the user via spoken or physical (e.g., touch gesture) responses. Continuing with the example above, when the task flow processor **336** invokes the dialogue processor **334** to determine the "party size" and "date" information for the structured query associated with the domain "restaurant reservation," the dialogue processor **334** generates questions such as "For how many people?" and "On which day?" to pass to the user. Once answers are received From the user, the dialogue processing module **334** populates the structured query with the missing information, or passes the information to the task flow processor **336** to complete the missing information from the structured query.

In some cases, the task flow processor **336** may receive a structured query that has one or more ambiguous properties. For example, a structured query for the "send a message" domain may indicate that the intended recipient is "Bob," and the user may have multiple contacts named "Bob." The task flow processor **336** will request that the dialogue processor **334** disambiguate this property of the structured query. In turn, the dialogue processor **334** may ask the user "Which Bob?", and display (or read) a list of contacts named "Bob" from which the user may choose.

In some implementations, dialogue processor **334** includes disambiguation module **350**. In some implementations, disambiguation module **350** disambiguates one or more ambiguous terms (e.g., one or more ambiguous terms in a text string corresponding to a speech input associated with a user interface setting), In some implementations, disambiguation module **350** identifies that a first term of the one or more terms has multiple candidate meanings, prompts a user for additional information about the first term, receives the additional information from the user in response to the prompt and identifies the entity, activity, location, or user interface setting associated with the first term in accordance with the additional information.

In some implementations, disambiguation module **350** disambiguates pronouns. In such implementations, disambiguation module **350** identifies one of the one or more terms as a pronoun and determines a noun to which the pronoun refers. In some implementations, disambiguation module **350** determines a noun to which the pronoun refers by using a contact list associated with a user of the electronic device. Alternatively, or in addition, disambiguation module **350** determines a noun to which the pronoun refers as a name of an entity, an activity, or a location identified in a previous speech input associated with a previously tagged media file, (e.g., a digital photograph).

In some implementations, disambiguation module **350** accesses system history information (e.g., settings history **394**) of an electronic device (e.g., user device **104**) for determining a meaning of one or more terms. In some implementations, disambiguation module **350** identifies a term associated with user difficulty (e.g., "why," "help," "trouble," "difficulty," "can't," or "how") or user frustration (e.g., "darn" or other words indicating frustration) and accesses settings history **394** to determine if a user interface setting has been changed recently, which may be causing the user difficulty. In some implementations, when more than one user interface setting has been changed, disambiguation module **350** prompts a user for additional information about their apparent difficulty. Disambiguation module **350** then uses the user's response to the prompt to determine which, if any, of the setting changes are causing the difficulty.

In some implementations, disambiguation module **350** accesses information obtained from one or more sensors (e.g., proximity sensor **214**, light sensor **212**, GPS receiver **213**, temperature sensor **215**, and motion sensor **210**) of a handheld electronic device (e.g., user device **104**) for determining a meaning of one or more of the terms. In some implementations, disambiguation module **350** identifies two terms each associated with one of an entity, an activity, or a location. For example, a first of the two terms refers to a person, and a second of the two terms refers to a location. In some implementations, disambiguation module **350** identifies three terms each associated with one of an entity, an activity, or a location.

Once the task flow processor **336** has completed the structured query for an actionable intent, the task flow processor **336** proceeds to perform the ultimate task associated with the actionable intent. Accordingly, the task flow processor **336** executes the steps and instructions in the task flow model according to the specific parameters contained in the structured query. For example, the task flow model for the actionable intent of-restaurant reservation" may include steps and instructions for contacting a restaurant and actually requesting a reservation for a particular party size at a particular time. For example, using a structured query such as: (restaurant reservation, restaurant=ABC Café, date=Mar. 12, 2012, time=7 pm, party size=5}, the task flow processor **336** may perform the steps of: (1) logging onto a server of the ABC Cafe or a restaurant reservation system that is configured to accept reservations for multiple restaurants, such as the ABC Cafe, (2) entering the date, time, and party size information in a form on the website, (3) submitting the form, and (4) making a calendar entry for the reservation in the user's calendar. In another example, described in greater detail below, the task flow processor **336** executes steps and instructions associated with restoring a user interface setting (e.g., turning off an accessibility feature), for example in conjunction with settings history module **140**.

In some implementations, the task flow processor **336** employs the assistance of a service processing module **338** ("service processor") to complete a task requested in the user input or to provide an informational answer requested in the user input. For example, the service processor **338** can act on behalf of the task flow processor **336** to make a phone call, set a calendar entry, invoke a map search, invoke or interact with other user applications installed on the user device, invoke or interact with third party services (e.g. a restaurant reservation portal, a social networking website or service, or a banking portal), or change a User interface setting (e.g., restore a user interface setting and/or turn off an accessibility feature). In some implementations, the protocols and application programming interfaces (API) required by each service can be specified by a respective service model among the service models **356**. The service processor **338** accesses the appropriate service model for a service and generates requests for the service in accordance with the protocols and APIs required by the service according to the service model.

For example, if a restaurant has enabled an online reservation service, the restaurant can submit a service model specifying the necessary parameters for making a reservation and the APIs for communicating the values of the necessary parameters to the online reservation service. When requested by the task flow processor **336**, the service processor **338** can establish a network connection with the online reservation service using the web address stored in the service models **356**, and send the necessary parameters of the reservation (e.g., time, date, party size) to the online reservation interface in a format according to the API of the online reservation service.

In some implementations, the natural language processor **332**, dialogue processor **334**, and task flow processor **336** are used collectively and iteratively to infer and define the user's intent, obtain information to further clarify and refine the user intent, and finally generate a response (e.g., provide an output to the user or complete a task) to fulfill the user's intent.

In some implementations, after all of the tasks needed to fulfill the user's request have been performed, the digital assistant **326** formulates a confirmation response, and sends the response back to the user through the I/O processing module **328**. If the user request seeks an informational answer, the confirmation response presents the requested information to the user. In some implementations, the digital assistant also requests the user to indicate whether the user is satisfied with the response produced by the digital assistant **326**. In some implementations, where the user was experiencing difficulty, the digital assistant also educates the user on how to perform a task (e.g., change a user interface setting or disable an accessibility feature) when Faced with a similar or the same situation.

In some implementations, the digital assistant **326** includes a diagnostics module **366**. In some implementations, the diagnostics module acts in conjunction with the task flow processing module **336** to search for recent user interface setting changes (e.g., in setting history **394**) in response to a user input (e.g., a request for help or abnormal pattern of user inputs).

In some implementations, the diagnostics module **366** includes a settings integration module **368** that acts in conjunction with the device settings **370** (e.g., accessibility **376**, language **378**, volume **380**, or display **382** settings) to diagnose an inadvertent activation of a user interface setting causing user difficulty, as explained in further detail with respect to Method **400** (FIGS. **4**A-**4**B) below. For example, in some implementations, the diagnostics module **366** receives a natural language text string corresponding to a user's input, where the intent has been inferred that the user is having difficulties with the device. The diagnostics module **366** consults the restoration module **390** (e.g., settings history **394**) to determine if a setting change has been made within a predetermined period of time (e.g., as tagged by a clock module **392**). The diagnostics module **366** identifies a setting change in the setting history **394** associated with the user's difficulty and acts in conjunction with the restoration module **390** to restore a prior user-interface setting (e.g., a user interface setting immediately preceding the identified setting change or a default user interface setting).

In accordance with some implementations, FIG. **4** shows a Functional block diagram of an electronic device **400** configured in accordance with the principles of the various described implementations. The functional blocks of the device are, optionally, implemented by hardware, software, or a combination of hardware and software to carry out the principles of the various described implementations. It is understood by persons of skill in the art that the functional blocks described in FIG. **4** are, optionally, combined or separated into sub-blocks to implement the principles of the various described implementations. Therefore, the description herein optionally supports any possible combination or separation or further definition of the functional blocks described herein.

As shown in FIG. **4**, an electronic device **400** includes a sound receiving unit configured to receive user utterances,

optionally, an input pattern receiving unit **404** configured to receive patterns of inputs from a user, a voice prompting unit **406** configured to prompt the user for additional information, and a processing unit **408** coupled to the sound receiving unit **402**, optional input pattern receiving unit **404**, and voice prompting unit **406**. In some implementations, the processing unit **408** includes a determining unit **410** and a setting restoring unit **412**.

The electronic device **400** is configured to receive a user input (e.g., with the sound receiving unit **402** or input pattern receiving unit **404**) indicating that the user is having difficulty operating the electronic device **400**. The processing unit is configured to determine whether a setting was changed on the device within a predetermined time period prior to receiving the user input (e.g., with the determining unit **410**). The processing unit **408** is further configured to, upon a determination that a first setting was changed within the predetermined time period prior to receiving the user input, restore the changed setting to a prior setting (e.g., with the setting restoring unit **412**).

In some implementations, the user input is a user voice input (e.g., that is received by the sound receiving unit **402** of electronic device **400**). In some implementations, the user input is an abnormal pattern of user inputs (e.g., that is received by the input pattern receiving unit **404**).

In some implementations, the predetermined time is a number of minutes. In some implementations, the predetermined time is a number of previous user sessions.

In some implementations, the prior setting is a default setting, In some implementations, the prior setting is a setting that immediately preceded a setting change.

In some implementations, the electronic device **400** is configured to, prior to restoring the changed setting, prompt the user with an indication that the first setting has been changed (e.g., with the voice prompting unit).

In some implementations, the electronic device **400** is further configured to, prior to restoring the changed setting, prompt the user to confirm that they are having difficulty operating the device (e.g., with the voice prompting unit **406**), and the processing unit **408** is further configured to, in response to receiving confirmation that the user is having difficulty operating the device, restore the changed setting to a prior setting (e.g., with the setting restoring unit **412**).

In some implementations, the electronic device **400** is further configured to, prior to restoring the changed setting, prompt the user to confirm that the first setting is causing the user difficulty (e.g., with the voice prompting unit **406**), and the processing unit is further configured to, in response to receiving confirmation that the first setting is causing the user difficulty, restore the changed setting to a prior setting (e.g., using the setting restoring unit **412**).

In some implementations, the processing unit **408** is further configured to, in response to receiving a user input indicating that the first setting is not causing the user difficulty, determine if a second setting was changed on the device within a predetermined time period prior to receiving the first user input (e.g., with the determining unit **410**).

In some implementations, the electronic device **400** is further configured to, prior to restoring the changed setting, prompt the user to confirm that they want to restore the changed setting to a prior setting (e.g., with the voice prompting unit **406**), and the processing unit **408** is further configured to, in response to receiving confirmation that the user wants to restore the changed setting, restore the changed setting to a prior setting (e.g., with the setting restoring unit **412**).

In some implementations, the voice prompting unit **406** includes the use of a text-to-speech function.

In some implementations, the processing unit **408** is further configured to explain to the user how the display feature was enabled (e.g., with the voice prompting unit **406**).

In some implementations, the processing unit **408** is further configured to explain to the user how to restore the changed setting to a prior setting (e.g., with the voice prompting unit **406**).

The operations in the information processing methods described above are, optionally implemented by running one or more functional modules in information processing apparatus such as general purpose processors (e.g., as described above with respect to FIG. **3**A) or application specific chips.

FIGS. **5**A-**5**B are flow diagrams illustrating a method **500** of diagnosing the inadvertent activation of a user interface setting and restoring a prior user interface setting when the user is having difficulty operating an electronic device, in accordance with some implementations. The method **500** is performed at an electronic device (e.g., electronic device **104**, FIGS. **1** and **2**) with a digital assistant **326** and settings **370**. Some operations of method **500** are, optionally, combined and/or the order of some operations is, optionally, changed. As described below, the method **500** provides an intuitive way to diagnose the inadvertent activation of a user interface setting and restore a prior user interface setting when a user is having difficulty operating an electronic device. The method reduces the cognitive burden on a user diagnosing the inadvertent activation of a user interface setting and restoring a prior user interface setting, thereby creating a more efficient human-machine interface.

In some implementations, an electronic device (e.g., electronic device **104**) receives (**502**) a user input indicating that the user is having difficulty operating the electronic device (e.g., user help request **602** in FIG. **6** or the detection of user difficulty **700** in FIG. **7**). For example, the user tells a digital assistant (e.g., digital assistant **326** in FIG. **3**A) that they are having difficulty operating the electronic device, or the electronic device detects an irregular pattern of user inputs that is not productive.

In some implementations, the user input indicating the user is having difficulty is an intentional input (e.g., request for help) made by the user. In some implementation, the user input is (**504**) a user voice input (e.g., user help request **602** in FIG. **6** or user query **802** in FIG. **8**). For example, the user: asks a digital assistant (e.g., digital assistant **326** in FIG. **3**A) for help; asks a digital assistant a question related to the operation or user interface of the electronic device: and/or expresses their frustration to a digital assistant. For example, the user asks the digital assistant a question related to their operational difficulty e.g.: "Why can't I see the entire graphical user interface display?"; "Why doesn't the notepad application launch when I contact the associated launch icon?"; or "Why are the colors displayed on my screen inverted'?" However, in some instances, the user does not use precise terms or syntax when asking the digital assistant for assistance, thus causing an ambiguous query, e.g.: "Why is everything so big on the screen?" (query **802** in FIG. **8**): "Why doesn't my notepad work?"; or "Why are the colors so Funky'?" In some implementations, disambiguation module **350** identifies a term associated with user difficulty (e.g., "why," "help," "trouble," "difficulty," "can't," or "how") or user frustration (e.g., "darn" or other words indicating frustration) as an indication that the user is experiencing difficulty operating the electronic device.

In some implementations, the user input indicating the user is having difficulty is an unintentional input made by the user, for example out of frustration or because they do not know what else to try.

In some implementations, the user input is (**506**) an abnormal pattern of user inputs. For example, the user turns the electronic device off and on more than a predetermined number of times over a given period of time (e.g., the user turns the device off and on more than three times in the span of 15 minutes) or turns the device on and off with an uncharacteristic user frequency (e.g., a user who usually turns the electronic device off once a day turns the device off and on four times in a single day). Or, for example, the user repeatedly makes an unproductive user input (e.g., a contact or gesture that is associated with the performance of a particular action on an electronic device operating under a first user interface setting, when the electronic device is operating under a second user interface setting in which the user input is not associated with the particular action), For example, a user repeatedly attempts to switch to a different application launch screen using a single-finger swipe gesture after a voice-over accessibility feature has been activated, requiring a three-finger swipe gesture to switch between application launch screens.

The electronic device (e.g., electronic device **104**) determines (**508**) whether a setting was changed on the device within a predetermined time period prior to receiving the user input. For example, after detecting a qualifying user input indicating the user is having operational difficulties, the electronic device queries a data store (e.g., stored in internal memory **302** in FIG. **3**A and/or external restoration service(s) **122-6** in FIG. **1**) including records of user interface setting changes made on the device (e.g., settings history **394**) against a predetermined time prior to detection of the user input (e.g., within the past hour, day, week).

As used herein, the term "predefined time" refers to either or both of a predetermined linear period of time (e.g., a number of minutes, hours, days, weeks, months, years) and a predetermined number of user sessions.

As used herein, the term "user session" refers to a continuous period of time over which a user interacts with an electronic device without interruption for more than a short period of time. For example, in some implementations, a user session is a period of time over which the user interacts (e.g., provides inputs, receives feedback, observes displayed content, etc.) with an electronic device without an interruption of at least 15 minutes. This, of course, is merely illustrative of an exemplary implementation and is in no way meant to be limiting. For example, in some implementations, an interruption lasting as short as 30 seconds may end a user session, while in other implementations, an interruption lasting as long as a day may not end a user session.

In some implementations, the predetermined time is (**510**) a number of minutes (e.g., 5, 10, 15, 30, 60, 120, 240, 1440). In some implementations, the predetermined time is any linear measure of time, for example, minutes, days, weeks, months, or years.

In some implementations, the predetermined time is (**512**) a number of user sessions (e.g., 1, 2, 3, 4, 5, 10, 25, 50, or more user sessions).

In some implementations, the predetermined time is a combination of a number of minutes and a number of user sessions. For example, in some implementations, the predetermined time is the longer of a predetermined number of minutes and a predetermined number of user sessions (e.g., the timeframe for a qualifying change in a user setting is the past three days only if the user has completed at least three user sessions or vice versa). In some implementations, the predetermined time is the shorter of a predetermined number of minutes and a predetermined number of user sessions (e.g., the timeframe for a qualifying change in a user setting is the past three days unless a user has completed at least ten user-sessions in less than three days).

In some implementations, the device prompts (**514**) the user with an indication that a first setting has been changed. For example, the device audibly and/or visibly tells the user that a setting (e.g., a display setting such as the size of objects displayed on an associated display, the color scheme of objects displayed on an associated display or the language used on an associated display, an audio setting such as the master volume of the system or the volume associated with a particular audio content; or a setting that defines an action performed in response to a particular user input) has recently been changed (e.g., the a digital assistant, such as digital assistant **326**, audibly says "Accessibility features were recently enabled.")

In some implementations, the device prompts (**516**) the user to confirm that they are having difficulty operating the device (e.g., prompt "Are you having trouble?" **902** from device **104** in FIG. **9**). For example, a digital assistant (e.g., digital assistant **326**) audibly and/or visually asks the user if they need assistance.

In some implementations, in response to receiving confirmation that the user is having difficulty operating the device (e.g., user response "Yes" **904** to prompt "Are you having trouble" **902** in FIG. **9**), the device restores (**518**) the changed setting to a prior setting. For example, user device **104** disables a voice-over accessibility feature in FIG. **9** (e.g., as indicated by prompt "OK, I have disabled the voice-over feature." **906**) after the user confirms they are having difficulty (e.g., by response "Yes" **904**).

In some implementations, where the device does not receive a confirmation that the user is having difficulty (e.g., the user responds that they are not having difficulty or the user does not respond at all), the device foregoes restoring the changed setting to a prior setting (e.g., "End" step **718** in FIG. **7**).

In some implementations, the device prompts (**520**) the user to confirm that the first setting is causing the user difficulty (e.g., prompt "Are you trying to use the notepad application?" **1006** in FIG. **10**). For example, a digital assistant (e.g., digital assistant **326**) audibly and/or visually asks the user if a user interface setting determined to have been changed within a predefined time is causing the user difficulty.

In some implementations, in response to receiving confirmation (e.g., confirmation "Yes" **1008** in FIG. **10**) that the first setting (e.g., locking of a notepad application in FIG. **10**) is causing the user difficulty, the device restores (**522**) the changed setting to a prior setting (e.g., device **104** restores an unlocked setting for the notepad application in FIG. **10**, as indicated by prompt "OK, I have unlocked the notepad application.")

In some implementations, in response to receiving a user input indicating that the first setting is not causing the user difficulty, the device determines (**524**) if a second setting was changed on the device within a predetermined time period prior to receiving the first user input. For example, after the device detects that the user is having difficulty (e.g., steps **602** and **702** in FIGS. **6** and **7**, respectively), and identifies a first setting change occurred within a predetermined time period prior to the detection of user difficulty (e.g., steps **604** and **708** in FIGS. **6** and **7**, respectively), and the user does not confirm that the identified setting change

is causing difficulty (e.g., "No" at steps **608** and **712** in FIGS. **6** and **7**, respectively), after optionally prompting the user for additional data (e.g., at steps **614** and **720** in FIGS. **6** and **7**, respectively), the device determines if a second user interface setting change occurred with the predetermined time prior to detection of the user difficulty (e.g., at steps **604** and **708**; n=2).

In some implementations, where more than one user interface setting has been changed within the predetermined time, loops of steps **604-606-608-614** and steps **708-710** ¬**712-720** assist the device (e.g., operating disambiguation module **350**) in determining which setting changes are responsible for the user difficulty in an iterative fashion (e.g., through a process of elimination in which the qualified user interface setting changes are queried to the user one by one, for example, starting with a user interface setting change that occurred most recently). In some implementations, where the device does not receive confirmation that the first setting change is causing user difficulty, when the device determines if a second user interface setting was changed with a predetermined time before detection of the user difficulty, the predetermined time is a second predetermined time longer than a first predetermined time (e.g., the device looks farther back in settings history **394** to find a second change).

In some implementations, the device prompts (**526**) the user to confirm that they want to restore the changed setting to a prior setting (e.g., prompt "Would you like to restore the default display settings?" **804** in FIG. **8**). For example, after the device detects user difficulty and identifies a user interface setting that was changed within the predetermined time prior to detection of the user difficulty, the device (e.g., using digital assistant **326**) audibly or visually asks the user if they want to change the setting, rather than automatically restoring a prior user interface setting, as in some implementations described herein.

In some implementations, in response to receiving confirmation that the user wants to restore the changed setting (e.g., confirmation "Yes please" **806** in FIG. **8**), the device restores (**528**) the changed setting to a prior setting (e.g., device **104** restores default settings in FIG. **8** after confirmation **806**, as indicated by prompt "OK, the settings have been restored" **808**).

Upon a determination that a first setting was changed within the predetermined time period prior to receiving the user input, the device restores (**530**) the changed setting to a prior setting (e.g., device **104**: restores default display settings in FIG. **8**, as indicated by prompt **808**: disables a voice-over feature in FIG. **9**, as indicated by prompt **906**: and unlocks a notepad application in FIG. **10**, as indicated by prompt **1010**).

In some implementations, the prior setting (e.g., the user interface setting being restored by the device when corresponding criteria are met) is a default setting (**532**). For example, the user interface setting is returned to, a "factory setting" or a default setting previously determined by the user (e.g., when first setting-up the electronic device or otherwise specifically configuring, a default user interface setting that may or may not override and/or replace a factory setting).

In some implementations, the prior setting is a setting that immediately preceded the setting change (**534**). In some implementations, rather than restoring a Factory or default user interface setting, as in accordance with some implementations described herein, the device (e.g., with diagnostics module **366**, restoration module **390**, or diagnostics module **366** in conjunction with restoration module **390**) queries a data store (e.g., settings history **394**) to determine the setting that immediately proceeded the identified setting change and restores (e.g., using restoration module **390**) the prior setting. For example, where a factory Font display setting is 10 Pt, a user customizes the user display by increasing the Font display setting to 14 pt at a first time. At a later time, the user inadvertently changes the font display setting to 48 pt, rendering the user display difficult to navigate. Upon detection that the user is experiencing difficulty with the increased font size, the device restores the font display setting to 14 pt.

In some implementations, the device explains (**536**) to the user how the setting was changed. For example, the device audibly or visually explains to user which steps were taken, or would be taken, to change the user interface setting that caused user difficulty, enabling the user to avoid inadvertently changing the setting again (e.g., so that the user doesn't accidentally activate an undesired accessibility feature).

In some implementations, the device explains (**538**) to the user how to restore the changes setting to a prior setting (e.g., the device audibly or visually explains to the user how to disable an activated accessibility feature). For example, a digital assistant (e.g., digital assistant **326**) audibly and/or visually walks the user through the steps necessary to restore a prior user interface setting under the changed user interface environment that caused the user difficulty. In some implementations, the device (e.g., using digital assistant **326**) explains how to restore a prior user interface setting before restoring (**530**) the prior setting. In some implementations, the device (e.g., using digital assistant **326**) explains how to restore a prior user interface setting while restoring (**530**) the prior setting (e.g., in a tutorial). In some implementations, the device (e.g., using digital assistant **326**) explains how to restore a prior user interface setting after restoring (**530**) the prior setting.

In some implementations of the methods, systems, and devices described above, prompting the user includes (**540**) the use of a text-to-speech function. In some implementations, prompting the user also includes the use of visually prompting the user.

In some implementations, one or more of the methods and systems described above for diagnosing an inadvertent activation of a user interface setting and restoring a prior user interface setting can be disabled by a user, e.g., through an application specific setting in application specific settings module **372**. For example, it may be desirable to disable implementations where the device initiates the method upon receiving a user input indicating the user is having difficulty operating the device (e.g., method **700**), when the device is operated by an elderly person, young child, or person with a disability who may appear to be having difficulty with an accessibility feature, but are actually not able to operate the device well in any setting.

It should be understood that the particular order in which the operations in FIGS. **5**A-**5**B have been described is merely exemplary and is not intended to indicate that the described order is the only order in which the operations could be performed. One of ordinary skill in the art would recognize various ways to reorder the operations described herein.

Exemplary Methods

Now that an overview of the methods and systems for diagnosing inadvertent activation of a user interface setting, such as an accessibility feature, and for restoring a prior user interface setting have been presented, exemplary methods will be presented in conjunction with FIGS. **6-10**. FIGS. **8-10** illustrate an exemplary electronic devices (e.g., user

device **104**) displaying graphical user interfaces (GUIs) **800**, **900**, and **1000**, respectively, on touch screen **112**. GUIs **800**, **900**, and **1000** include a dialog between the user (e.g., as indicated by text bubbles originating from the right side of touch screen **112**) and a voice-based digital assistant (e.g., as indicated by text bubbles originating from the left side of touch screen **112**).

FIGS. **6** and **8** illustrate exemplary method **600** for diagnosing inadvertent activation of a user interface setting (e.g., an accessibility feature) and for restoring a prior user interface setting, in accordance with some implementations, where the user initiates the method.

In step **602**, the user provides a request For help operating an electronic device (e.g., electronic device **104**) to a voice-based digital assistant (e.g., digital assistant **326**) associated with the electronic device. In some implementations, the request for help need not necessarily include the word "help" or any synonym thereof, any indication that the user is experiencing difficulty operating the device and that the difficulty may relate to a user-interface setting (e.g., a display, audio, or operational user interface setting) is sufficient to activate execution of method **600**. For example, user input "Why is everything so big on the screen?" **802** is sufficient at least because it indicates the user is having difficulty operating the device (e.g., the user has to ask "why?"), and it indicates that the difficulty may relate to a user interface setting (e.g., the font and/or icon display size).

In some implementations, the voice-based digital assistant is accessible to the user through a default mechanism that cannot be disabled by a change to any user interface setting, including without limitation, accessibility Features, display settings, operational settings, volume settings, etc. In some implementations, the voice-based digital assistant is activated by a tactile input on the electronic device, e.g., by a double tap input on home button **810** of user device **104** in FIG. **8**. In some implementations, the voice-based digital assistant is activated by a voice input or signal, e.g., by use of a phrase recognized by the voice-based digital assistant such as "Hi Siri."

In step **604**, the electronic device determines whether a user interface setting was recently changed on the device (e.g., within a predetermined time prior to receiving the user input in step **602**). In some implementations, the device queries a data store (e.g., settings history **394** stored locally in memory **302** of the device or stored externally such as by a restoration service **122-6**) to determine if a user interface setting change was made within a predetermined time period (e.g., within a number of minutes and/or user sessions prior to the detection of the user difficulty).

In some implementations where the outcome of step **604** is "No," the device prompts the user for additional information on their operational difficulty. Additional data received from the user in response is used by the device (e.g., using disambiguation module **350**) to identify whether a second user interface setting was changed within a predetermined time of receiving the user input in step **602**, in a second iteration of step **604**. In some implementations, where the number of iterations (n) of step **604** is less than a threshold number (x), additional inputs from the user indicating that an identified user interface setting change is not causing user difficulty in step **604** cause the device to prompt the user for additional information regarding their operational difficulty in an additional iteration of step **614**. In some implementations, where the number of iterations (n) is equal to a threshold number (x), the device prompts the user to contact a customer service (e.g., by phone, email, text message, or SMS) in step **616**, providing the user with an opportunity for additional technological support and avoiding an infinite loop. In some implementations, where the user responds affirmatively to the prompt provided in step **616**, the device initiates contacting a customer service (e.g., by placing a phone call, sending an email, or sending a text message or SMS) in step **618**. In some implementations, where the user responds negatively to the prompt provided in step **616**, the device ends method **600** in step **620**.

In some implementations, where the outcome of step **604** is "Yes," an identified user interface setting was recently changed, the device asks the user to confirm that the identified user interface setting change is causing the user difficulty in step **606**. In some implementations, asking for user confirmation includes asking if the user wants to restore a previous user interface setting. For example, prompt "Would you like to restore the default display settings?" **804**. In some implementations, asking the user to confirm if an identified user interface setting is causing difficulty and asking the user to confirm if they wish to restore a prior user interface setting are performed in separate steps (e.g., they require separate confirmations from the user). In some implementations, only one of asking the user to confirm if an identified user interface setting is causing difficulty and asking the user to confirm if they wish to restore a prior user interface setting is performed.

In some implementations, the device receives confirmation that the identified user interface setting change is causing the user difficulty, and/or, in some implementations, confirmation to restore a prior user interface setting in step **608**. For example, confirmation "Yes please" **806** from the user. In response, the device restores a prior user interface setting in step **610** (e.g., disables an accessibility feature). For example, user device **104** restores a default display setting in response to user response **806**, as indicated by prompt "OK, the settings have been restored" **808**, in FIG. **8**.

In some implementations, steps **606** and **608** are not performed, and in response to a determination that a first setting was changed within the predetermined time period prior to receiving the user input in step, the device restores a prior user interface setting in step **610** (e.g., disables an accessibility feature).

In some implementations, before, during, or after restoring a prior user interface setting in step **610**, the device educates the user on how to avoid changing the identified user interface setting again (e.g., by educating the user on how the user interface setting was changed) in step **612**. In some implementations, before, during, or after restoring a prior user interface setting in step **610**, the device additionally or alternatively educates the user on how to restore a prior user interface setting (e.g., how to disable an accessibility feature).

In some implementations, where the outcome of step **608** is "No," the device prompts the user for additional information on their operational difficulty. Additional data received from the user in response is used by the device (e.g., using disambiguation module **350**) to identify whether a second user interface setting was changed within a predetermined time of receiving the user input in step **602**, in a second iteration of step **604**. In some implementations, where the number of iterations (n) of step **608** is less than a threshold number (y), additional inputs from the user indicating that an identified user interface setting change is not causing user difficulty in step **604** cause the device to prompt the user for additional information regarding their operational difficulty in an additional iteration of step **614**. In some implementations, where the number of iterations (n) is

equal to a threshold number (y), the device prompts the user to contact a customer service (e.g., by phone, email, text message, or SMS) in step **616**, providing the user with an opportunity for additional technological support and avoiding an infinite loop. In some implementations, where the user responds affirmatively to the prompt provided in step **616**, the device initiates contacting a customer service (e.g., by placing a phone call, sending an email, or sending a text message or SMS) in step **618**. In some implementations, where the user responds negatively to the prompt provided in step **616**, the device ends method **600** in step **620**.

FIGS. **7**, **9**, and **10** illustrate exemplary method **700** for diagnosing inadvertent activation of a user interface setting (e.g., an accessibility feature) and for restoring a prior user interface setting, in accordance with some implementations, where the electronic device initiates the method.

In step **702**, an electronic device (e.g., electronic device **104**) detects a pattern of user inputs indicating that a user is experiencing difficulty operating the electronic device. For example, in some implementations, the device detects an abnormal pattern of user inputs (e.g., corresponding to the user: repeatedly turning the device off and on: repeatedly logging off and on to a workspace; repeatedly executing a touch or gesture not associated with an operation under a particular user interface environment; etc.) indicating the user is experiencing difficulty.

In some implementations, in response to the detection of an apparent user difficulty, the device asks the user if they are experiencing difficulty (e.g., using a voice-based digital assistant such as digital assistant **326**) operating the electronic device in step **704**. For example, user device provides audible and/or visible prompts "Are you having trouble?" **902** and **1002** in FIGS. **9** and **10**, respectively (e.g., using voice-based digital assistant **326**).

In some implementations, the device detects a user response indicating that they are experiencing difficulty operating the device (e.g., user responses "Yes" **904** and **1004** in FIGS. **9** and **10**, respectively). In some implementations, where the device does not receive a user response confirming the operational difficulty in step **706**, the device ends method **700** in step **718**.

In step **708**, the electronic device determines whether a user interface setting was recently changed on the device (e.g., within a predetermined time prior to receiving the user input in step **702**). In some implementations, the device queries a data store (e.g., settings history **394** stored locally in memory **302** of the device or stored externally such as by a restoration service **122-6**) to determine if a user interface setting change was made within a predetermined time period (e.g., within a number of minutes and/or user sessions prior to the detection of the user difficulty).

In some implementations where the outcome of step **708** is "No," the device prompts the user For additional information on their operational difficulty. Additional data received from the user in response is used by the device (e.g., using disambiguation module **350**) to identify whether a second user interface setting was changed within a predetermined time of receiving the user input in step **702**, in a second iteration of step **708**. In some implementations, where the number of iterations (n) of step **708** is less than a threshold number (x), additional inputs from the user indicating that an identified user interface setting change is not causing user difficulty in step **708** cause the device to prompt the user for additional information regarding their operational difficulty in an additional iteration of step **720**. In some implementations, where the number of iterations (n) is equal to a threshold number (x), the device prompts the user to contact a customer service (e.g., by phone, email, text message, or SMS) in step **722**, providing the user with an opportunity for additional technological support and avoiding an infinite loop. In some implementations, where the user responds affirmatively to the prompt provided in step **722**, the device initiates contacting a customer service (e.g., by placing a phone call, sending an email, or sending a text message or SMS) in step **724**. In some implementations, where the user responds negatively to the prompt provided in step **722**, the device ends method **700** in step **726**.

In some implementations, where the outcome of step **708** is "Yes," an identified user interface setting was recently changed, the device asks the user to confirm that the identified user interface setting change is causing the user difficulty in step **710**. For example, prompt "Are you trying to use the notepad application?" **1006**. In some implementations, asking for user confirmation includes asking if the user wants to restore previous user interface setting. In some implementations, asking the user to confirm if an identified user interface setting is causing difficulty and asking the user to confirm if they wish to restore a prior user interface setting are performed in separate steps (e.g., they require separate confirmations from the user). In some implementations, only one of asking the user to confirm if an identified user interface setting is causing difficulty and asking the user to confirm if they wish to restore a prior user interface setting is performed.

In some implementations, the device receives confirmation that the identified user interface setting change is causing the user difficulty, and/or, in some implementations, confirmation to restore a prior user interface setting in step **712**. For example, confirmation "Yes" **1008** from the user. In response, the device restores a prior user interface setting in step **714** (e.g., disables an accessibility feature). For example, user device **104** unlocks an application in response to user response **1008**, as indicated by prompt "OK, 1 have unlocked the notepad application" **1010**, in FIG. **10**.

In some implementations, steps **710** and **712** are not performed, and in response to a determination that a first setting was changed within the predetermined time period prior to receiving the user input in step, the device restores a prior user interface setting in step **714** (e.g., disables an accessibility feature). For example, user device **104** disables an accessibility feature, as indicated by prompt "OK, I have disabled the voice-over feature" **906**, in FIG. **9**.

In some implementations, before, during, or after restoring a prior user interface setting in step **714**, the device educates the user on how to avoid changing the identified user interface setting again (e.g., by educating the user on how the user interface setting was changed) in step **716**. In some implementations, before, during, or after restoring a prior user interface setting in step **714**, the device additionally or alternatively educates the user on how to restore a prior user interface setting (e.g., how to disable an accessibility feature) in step **716**.

In some implementations, where the outcome of step **712** is "No," the device prompts the user for additional information on their operational difficulty. Additional data received from the user in response is used by the device (e.g., using disambiguation module **350**) to identify whether a second user interface setting was changed within a predetermined time of receiving the user input in step **702**, in a second iteration of step **708**. In some implementations, where the number of iterations (n) of step **712** is less than a threshold number (y), additional inputs from the user indicating that an identified user interface setting change is not causing user difficulty in step **712** cause the device to prompt

the user for additional information regarding their operational difficulty in an additional iteration of step **720**. In some implementations, where the number of iterations (n) is equal to a threshold number (y), the device prompts the user to contact a customer service (e.g., by phone, email, text message, or SMS) in step **722**, providing the user with an opportunity for additional technological support and avoiding an infinite loop. In some implementations, where the user responds affirmatively to the prompt provided in step **722**, the device initiates contacting a customer service (e.g., by placing a phone call, sending an email, or sending a text message or SMS) in step **724**. In some implementations, where the user responds negatively to the prompt provided in step **722**, the device ends method **700** in step **726**.

The foregoing description, for purpose of explanation, has been described with reference to specific implementations. However, the illustrative discussions above are not intended to be exhaustive or to limit the disclosed implementations to the precise Forms disclosed. Many modifications and variations are possible in view of the above teachings. The implementations were chosen and described in order to best explain the principles and practical applications of the disclosed ideas, to thereby citable others skilled in the art to best utilize them with various modifications as are suited to the particular use contemplated.

It will be understood that, although the terms "first," "second," etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first sound detector could be termed a second sound detector, and, similarly, a second sound detector could be termed a first sound detector, without changing the meaning of the description, so long as all occurrences of the "first sound detector" are renamed consistently and all occurrences of the "second sound detector" are renamed consistently. The first sound detector and the second sound detector are both sound detectors, but they are not the same sound detector.

The terminology used herein is for the purpose of describing particular implementations only and is not intended to be limiting of the claims, As used in the description of the implementations and the appended claims, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will also be understood that the term "and/or" as used herein refers to and encompasses any and all possible combinations of one or more of the associated listed items. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers. steps, operations, elements, components, and/or groups thereof.

As used herein, the term "if" may be construed to mean "when" or "upon" or "in response to determining" or "in accordance with a determination" or "in response to detecting," that a stated condition precedent is true, depending on the context. Similarly, the phrase "if it is determined [that a stated condition precedent is true]" or "if [a stated condition precedent is true]" or "when [a stated condition precedent is true]" may be construed to mean "upon determining" or "upon a determination that" or "in response to determining" or "in accordance with a determination" or "upon detecting" or "in response to detecting" that the stated condition precedent is true, depending on the context.

What is claimed is:

1. A method, comprising:

at an electronic device comprising a processor and memory storing instructions for execution by the processor:

while the device is operating with a first setting in a first state, detecting, at a first time, a change in settings of the device to change the first setting from the first state to a second state that is different from the first state;

while the device is operating with the first setting in the second state, receiving, at a second time that is after the first time, a user input that corresponds to a pattern of user behavior, wherein the user input is a user voice input;

in response to receiving the user input:

comparing the pattern of user behavior to a plurality of predefined conditions that, when met, indicate that the user is having difficulty with operating the device, wherein a predefined condition of the plurality of predefined conditions includes the user voice input containing one or more predetermined words associated with user difficulty;

in accordance with a determination, based on the comparison of the pattern of user behavior to the plurality of predefined conditions, that the device changed the first setting from the first state to the second state within a predetermined time period prior to receiving the user input, restoring the first setting to the first state; and

in accordance with a determination, based on the comparison of the pattern of user behavior to the plurality of predefined conditions, that the user is not having difficulty with operating the device, maintaining the first setting in the second state.

2. The method of claim **1**, wherein a second predefined condition of the plurality of predefined conditions includes the device being turned off and on more than a predetermined number of times over a predetermined period of time.

3. The method of claim **1**, wherein the predetermined time is a predetermined number of minutes.

4. The method of claim **1**, wherein the predetermined time is a predetermined number of user sessions.

5. The method of claim **1**, wherein the first state of the first setting is a default state of the first setting.

6. The method of claim **1**, wherein a third predefined condition of the plurality of predefined conditions includes repeatedly detecting gesture input that is applicable to the first state of the first setting but not applicable to the second state of the first setting.

7. The method of claim **1**, further comprising:

prior to restoring the first setting to the first state, prompting the user with an indication that the first setting has changed from the first state to the second state.

8. The method of claim **1**, further comprising:

prior to restoring the first setting to the first state, prompting the user to confirm that they are having difficulty with operating the device; and

in response to receiving confirmation that the user is having difficulty with operating the device, restoring the first setting to the first state.

9. The method of claim **1**, further comprising:

prior to restoring the first setting to the first state, prompting the user to confirm that the device operating with the first setting in the second state is causing the user difficulty with operating the device; and

in response to receiving confirmation that the device operating with the first setting in the second state is causing the user difficulty with operating the device, restoring the first setting to the first state.

10. The method of claim **9**, further comprising:

in response to receiving a second user input indicating that the device operating with the first setting in the second state is not causing the user difficulty with operating the device, determining if a second setting was changed on the device within a predetermined time period prior to receiving the user input.

11. The method of claim **1**, further comprising:

prior to restoring the first setting to the first state, prompting the user to confirm that they want to restore the first setting to the first state; and

in response to receiving confirmation that the user wants to restore the first setting to the first state, restoring the first setting to the first state.

12. An electronic device, comprising:

a processor;

memory; and

one or more programs, wherein the one or more programs are stored in the memory and configured to be executed by the one or more processors, the one or more programs including instructions for:

while the device is operating with a first setting in a first state, detecting, at a first time, a change in settings of the device to change the first setting from the first state to a second state that is different from the first state;

while the device is operating with the first setting in the second state, receiving, at a second time that is after the first time, a user input that corresponds to a pattern of user behavior, wherein the user input is a user voice input;

in response to receiving the user input:

comparing the pattern of user behavior to a plurality of predefined conditions that, when met, indicate that the user is having difficulty with operating the device, wherein a predefined condition of the plurality of predefined conditions includes the user voice input containing one or more predetermined words associated with user difficulty;

in accordance with a determination, based on the comparison of the pattern of user behavior to the plurality of predefined conditions, that the device changed the first setting from the first state to the second state within a predetermined time period prior to receiving the user input, restoring the first setting to the first state; and

in accordance with a determination, based on the comparison of the pattern of user behavior to the plurality of predefined conditions, that the user is not having difficulty with operating the device, maintaining the first setting in the second state.

13. The electronic device of claim **12**, wherein a second predefined condition of the plurality of predefined conditions includes repeatedly detecting gesture input that is applicable to the first state of the first setting but not applicable to the second state of the first setting.

14. The electronic device of claim **12**, wherein a third predefined condition of the plurality of predefined conditions includes the device being turned off and on more than a predetermined number of times over a predetermined period of time.

15. The electronic device of claim **12**, further comprising instructions for:

prior to restoring the first setting to the first state, prompting the user with an indication that the first setting has changed from the first state to the second state.

16. The electronic device of claim **12**, further comprising instructions for:

prior to restoring the first setting to the first state, prompting the user to confirm that they are having difficulty with operating the device; and

in response to receiving confirmation that the user is having difficulty with operating the device, restoring the first setting to the first state.

17. The electronic device of claim **12**, further comprising instructions for:

prior to restoring the first setting to the first state, prompting the user to confirm that the device operating with the first setting in the second state is causing the user difficulty with operating the device; and

in response to receiving confirmation that the device operating with the first setting in the second state is causing the user difficulty with operating the device, restoring the first setting to the first state.

18. The electronic device of claim **17**, further comprising instructions for:

in response to receiving a second user input indicating that the device operating with the first setting in the second state is not causing the user difficulty with operating the device, determining if a second setting was changed on the device within a predetermined time period prior to receiving the user input.

19. A non-transitory computer readable storage medium storing one or more programs, the one or more programs comprising instructions, which when executed by an electronic device, cause the device to:

while the device is operating with a first setting in a first state, detect, at a first time, a change in settings of the device to change the first setting from the first state to a second state that is different from the first state;

while the device is operating with the first setting in the second state, receive, at a second time that is after the first time, a user input that corresponds to a pattern of user behavior, wherein the user input is a user voice input;

in response to receiving the user input:

compare the pattern of user behavior to a plurality of predefined conditions that, when met, indicate that the user is having difficulty with operating the device, wherein a predefined condition of the plurality of predefined conditions includes the user voice input containing one or more predetermined words associated with user difficulty;

in accordance with a determination, based on the comparison of the pattern of user behavior to the plurality of predefined conditions, that the device changed the first setting from the first state to the second state within a predetermined time period prior to receiving the user input, restore the first setting to the first state; and

in accordance with a determination, based on the comparison of the pattern of user behavior to the plurality of predefined conditions, that the user is not having difficulty with operating the device, maintain the first setting in the second state.

20. The non-transitory computer readable storage medium of claim **19**, wherein a second predefined condition of the plurality of predefined conditions includes the device being turned off and on more than a predetermined number of times over a predetermined period of time.

21. The non-transitory computer readable storage medium of claim **19**, further comprising instructions for:

prior to restoring the first setting to the first state, prompting the user with an indication that the first setting has changed from the first state to the second state.

22. The non-transitory computer readable storage medium of claim **19**, further comprising instructions for:

prior to restoring the first setting to the first state, prompting the user to confirm that they are having difficulty with operating the device; and

in response to receiving confirmation that the user is having difficulty with operating the device, restoring the first setting to the first state.

23. The non-transitory computer readable storage medium of claim **19**, further comprising instructions for:

prior to restoring the first setting to the first state, prompting the user to confirm that the device operating with the first setting in the second state is causing the user difficulty with operating the device; and

in response to receiving confirmation that the device operating with the first setting in the second state is causing the user difficulty with operating the device, restoring the first setting to the first state.

24. The non-transitory computer readable storage medium of claim **23**, further comprising instructions for:

in response to receiving a second user input indicating that the device operating with the first setting in the second state is not causing the user difficulty with operating the device, determining if a second setting was changed on the device within a predetermined time period prior to receiving the user input.

* * * * *